INTRODUCTION TO EDUCATIONAL PSYCHOLOGY

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PREFACE

In preparing the present volume the aim has been to provide an introduction to the science of psychology and to its applications in the field of education. Undoubtedly some will object to the choice of material here presented, but in an elementary book it is, of course, impossible and unwise to include all that a mature scholar might desire.

The criteria of general interest and of importance in educational theory and practice have been employed throughout as bases of selection. The more important psychological techniques are described, but the emphasis is on the significant findings which contribute to an understanding of oneself and one's acquaintances as well as of the pupils one is expected to teach. Such an understanding cannot but make more intelligible both the process of learning and the nature of educational procedures, thus furnishing a basis for judgment in matters of instructional and administrative policy.

Since the differences separating the schools of psychology are at last coming to be recognized largely as differences in emphasis, techniques, experimental subjects used — and technical vocabulary — the material here presented is for the most part that about which there is fairly general agreement, at least so far as the facts are concerned. In certain instances, where the contributions of a school of thought have implications for psychological insight or educational procedure, the fact is noted, leaving the systematic presentation of the point of view to individual inquiry or to later study. This plan makes it possible to avoid the overemphasis on measurements, mental hygiene, perception, or conditioning, and so on, which

is often found, and at the same time it provides an outline of psychology which can gradually be filled in later.

Important as individual researches are in an advanced study of any field, to the beginner they often present unnecessary difficulties, when the names of experimenters seem to overshadow in importance the experimental findings. Hence only a few names of psychologists chosen from those who have made outstanding contributions are included in the body of the text. The notes at the end of each chapter serve to identify many studies to which reference is made and to indicate bibliographical sources for further reading.

Reference is made at the close of the chapter notes to the two most recent volumes of source material, the *Readings in Psychology* and the *Readings in Educational Psychology*, both edited by Charles E. Skinner and published by Farrar and Rinehart. Owing to the unevenness in difficulty and applicability of the excerpts in these volumes, selection may well be made of readings which are to be assigned. Reference is likewise made to the *Sourcebook in Social Psychology* edited by Kimball Young and published by Knopf, and to Henry E. Garrett's *Great Experiments in Psychology*, published by The Century Company, both of which provide excellent reading materials.

While a few of the cuts appearing in my *Educational Psychology* are reproduced in this volume, beyond this there is little that is the same in the two books. The *Educational Psychology* was written for those who had previously studied psychology, while the *Introduction to Educational Psychology* assumes no previous psychological knowledge.

The list of supplementary readings at the close of the volume is in a way an innovation. Group I represents a good working library in the field. Group II, however, includes titles to volumes which are more popular than academic, but which, it is

believed, may give an appreciation of the nature of scientific thinking, or of psychological or educational theory, which will be enjoyable as well as enlightening.

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CHAPTER I

THE FIELD OF PSYCHOLOGY

Human behavior. There seems to be almost no limit to the things that man can do. But numberless as his activities are, certain kinds of behavior recur again and again. For example, people move from place to place, they want and need certain things to sustain life, like food and warmth, they show emotion — love, hate, fear, or anger — and they converse and do business with one another. They can perceive the world about them with their eyes and ears and other sense organs, they react to various objects and situations, they acquire skill and knowledge, solve problems, and create works of greater or less value or artistic merit.

But they cannot do all these things right at first. The infant matures slowly with the years, becoming a child, a youth, an adult; and during this period of development he learns how to do many things that he enjoys doing and that he must do in order to live. In learning, as well as in many other ways, he is similar to others of his age, but he is different, too. Some of these individual similarities and differences are matters of common knowledge, but more is constantly being learned about them through scientific investigations of human behavior.

I. PSYCHOLOGY APPLIED TO EDUCATION

The nature of the pupil. Each pupil who enters the school is biologically a unique individual. He has derived his inheritance from his parents, grandparents, and more remote

forebears; and although he differs from those who have gone before, in large measure he is what he is because of them. His height and weight, for example, the color of his skin, hair, and eyes, the shape of his face, his general level of intelligence, and even his temperament and disposition were in all essential respects transmitted to him by heredity.

But his inherited structure, important as it is in determining his peculiar nature, is only the raw material for his development. Before he came to school, he lived in a family of a certain kind. He was cared for or neglected, petted or abused, allowed to have his way or severely disciplined. He accepted the speech habits, the vocabulary, the manners, the beliefs, and the way of living of his elders and made them his own.

And yet, in spite of the influences of his heredity and home background, he is himself. He is like other children in that he is a child; but he is unlike them in many important respects. When he enters school, with a host of other children, he will be found to have a combination of abilities, aptitudes, wants, interests, attitudes, and needs which are peculiar to him, and which demand individual attention on the part of his teachers.

In his school he will be expected to acquire, so far as his abilities permit, the skills and knowledge required by the culture in which he is to live, and it is his privilege to gain the experience in group living which will enable him to make adequate social adjustment. If he has any special abilities or talents, they will find encouragement for his own good and for that of the society to which he may be expected to make a contribution.

Discovery of individual needs. Since all children are different, they cannot be treated in the same way if each is to develop his inborn capacities to the fullest. But the task of discovering what is best for each individual child is obviously

not an easy one. In spite of this, there are always those who are ready to announce, on the basis of the scantiest of data, just what it is a certain child needs. "He ought to be made to work," they say, or "He needs sympathy and encouragement," or "What he needs is a good licking!" But such judgments, while they may be correct, are quite as apt to be wrong, especially if they are based on too little knowledge of child nature, or on somewhat vague recollections of the speaker's childhood years.

To replace individual judgment and guesswork, psychological knowledge is accumulating and scientific techniques are being developed, with the result that changes in the educational processes are constantly being made. To aid individual judgments, for example, the schools employ surprisingly accurate measuring devices. These are used to discover the child's native, inherited ability, the extent of his mastery of his allotted tasks, and the quality of his reactions to different kinds of situations. The difficulties presented by various school subjects and activities are weighed, and a pupil's program is worked out in terms of his abilities, interests, and expected accomplishments. His failures in school work and in social adjustment are viewed, not as wrongdoing, but as evidence that the school has not set up the right situation, provided the right motivation, or adopted the best method of control.

Adapting to individual needs. In the light of such tests and records as are available, a curriculum is drawn up embodying carefully chosen samples of the events, activities, and ideals of the world outside which are thus brought into the school and which will contribute most to individual development.

Such an educational ideal demands a much broader program than was formerly provided, and necessitates a more extensive equipment including workrooms, music rooms,

shops, libraries, gymnasiums, and auditorium, as well as classrooms and laboratories. It means that children will not only acquire knowledge and skills, but that they will also learn how to work and play together.

Appraisal. The degree of success with which the school accomplishes its purposes is not easy to determine accurately. Desired outcomes have to be set up and techniques developed to measure the extent to which children of varying abilities approach these standards. Measurements of many kinds have to be taken over extended periods of time, and records kept, analyzed, and compared. But psychological knowledge and techniques are being employed in these ways with the result that much is being found out about the nature of children, their differences, the way they learn, and their growth and development.

2. PSYCHOLOGY APPLIED TO OTHER FIELDS [1]

Business and industry. Psychological knowledge and techniques are applicable in other human relationships than in those of the school. For the selection of employees, for example, some industries have developed rating devices which tend to cut down the error of individual judgments. Laboratory instruments have been invented to be operated by applicants for jobs to discover the abilities and skills they possess which may qualify them for particular kinds of work or for handling certain machines.

The *time-and-motion* study and the *job analysis* have furnished detailed information concerning the motions the individual makes and the several things he has to do on a given job, and these results have been helpful in training employees. Devices increasing the *safety* of various occupations have been developed, and the causes of accidents sought and often found

in psychological factors. The speed of reaction of the auto mobile driver in applying the brake, for example, is importan in highway safety.

In *advertising*, the appeal of various forms and colors, anc of pictures and slogans has been studied as, for example, tha of sex, luxury, authority, emulation, and health. In *sales manship*, numerous ways of approach, of breaking dowr "sales resistance," and bringing about customer satisfaction have been announced, many of them, however, derived fron experience rather than from controlled scientific study.

Religion and art. The psychological factors in religior are, many of them, so complex as to defy laboratory experimentation, though there has been much study of the varietie of religious experience, of conversion, the influence of symbolism and ritual, and the nature of the human needs which are satisfied by superstition, ceremonial, and belief, as well as o the development of theological concepts in children anc adolescents.

The same uncertainty maintains in regard to esthetic experience, whether in relation to music, art, or literature, as in the field of religion. Yet a start has been made in experimental esthetics, and in the gathering of knowledge about the beginning of appreciation and creative development as, for example, in connection with the analysis and comparison o children's drawings and poetic efforts.

Medicine and psychiatry. Only recently has there come to be included in the practice of medicine any emphasis on psychological factors. The old-fashioned family doctor, if he was a good one, knew his patients, and his visits often did more good than his pills, while the modern specialist has too often thought of his work as dealing with diseases instead of with people. The modern trend is to be noted here and there in the humanization of hospital service and equipment,

and in the consideration of the attitude and outlook of the patient.

A *psychiatrist* or alienist is a physician who works with those with diseased or disordered minds. The study of the behavior and mental processes of such patients is often classed under the head of *abnormal psychology*, because the emotional life, the thinking, and actions of such persons, who are variously called insane, psychopathic, and neurotic, is abnormal or quite different from what is commonly found.

A promising relationship of medicine and psychology is to be found in the work of the physiologists and biochemists, for to a large degree the functioning of the individual is dependent on his nerves and muscles and on the action of his glands. The facts found out about these structures have important implications not only for medicine but for psychology and education as well.

3. TECHNIQUES OF PSYCHOLOGICAL RESEARCH

Intuition and anecdote. The foregoing paragraphs have perhaps suggested that some of the phases of psychological knowledge, whether or not it is applied to practical problems, are much farther advanced than some others. Any science has its beginnings in practical appliances and in speculation. Early astronomy was useful to navigators if a bit speculative as to the place of gods in celestial mechanics. Classical geography charted the familiar seas and promontories, but the outlines of the Western Ocean were vague and its inhabitants legendary. Similarly, psychology, which in many respects is in a rather primitive stage of development, still embodies the conclusions from practical experience and many guesses and speculative surmises.

The guesses or "hunches" that people have without their

being sure of the data on which they are based, are called *intuitions*. Examples of such intuitions might be that quick learners are quick forgetters, that what one likes to eat is good for him, that drill or uninteresting school work is a good preparation for life, or that rewards make learning more rapid. Intuitions may turn out to be true in certain cases, but they may be false in others. They are usually "half truths" on which more scientific research is needed to find out the conditions under which they are true or false.

"Armchair psychology" is the somewhat derisive term which is sometimes applied to speculations concerning the nature of the mind based on one's own experience and introspections and accepted as true for mankind in general. The following[2] is an example of such armchair speculation:

> Thought succeeds thought; idea follows idea, incessantly.... I see a horse: that is a sensation. Immediately I think of his master: that is an idea. The idea of his master makes me think of his office; he is a minister of state: that is another idea. ... Our ideas spring up, or exist, in the order in which the sensations existed, of which they were the copies.... This is the general law of the "Association of Ideas."

Such speculations are recognized as valid only if they are found to check with the facts, if controlled research on a large number of individuals gives the same conclusions

Armchair speculation is sometimes aided by anecdotes, and upon these two methods rest much of what once passed for knowledge, and what, today, is often accepted for truth about the behavior of pet animals, and even of children. The anecdotalist, be it said to his credit, collects data for his generalizations, but the data may be of dubious validity, since they may include tall stories reported second or third hand, which have lost nothing in the retelling. And there is danger, even if the

anecdote is reported correctly, that conclusions drawn from the case observed may not be true in general.

For example, one famous anecdotalist[3] reports that a sea captain, having suspected that some member of his crew was stealing eggs from the ship's larder, stationed himself where he could catch the thief and observed that rats were the real culprits. They stood in line between the egg basket and the rat hole and handed them to each other until all the eggs had disappeared. Mothers' anecdotes reporting the bright remarks of their children are frequently heard, though no one would think of basing a study of child psychology on them.

Techniques are being developed, however, by which anecdotes of pupil behavior are systematically recorded by teachers and made a part of the child's permanent school record. A few sample entries from an anecdotal record[4] follow:

Date	*Observer*	*Anecdotal Record*
September	Supervisor	Her stunt in the retailing party was highly original. She is apparently unpopular with members of her own group.
September	Teacher 5	Many mannerisms and not very tactful.
November	Teacher 9	Monopolizes group discussions.
December	Teacher 8	She tells me that students do not like her. I have tried to explain what I think in her manner antagonizes but I don't get it across as I have similar characteristics.
April	Teacher 7	She gives other students opportunity to discuss and to work out their share of group assignments.
May	Teacher 8	In the sorority, has become the person (next to the president) to whom people turn for suggestions, assistance, and leadership. This is true of those who at first resented her.

Such data, collected over a period of years, furnish material for a better understanding of the development of an individual than could be obtained without them, and prove to be of value in educational and vocational guidance.

Observation. To find out the truth, it is necessary for the

scientist to make a number of careful observations and then, as a result of a study of the records of these observations, to make tentative generalizations, which must be subjected to careful scrutiny before much reliance can be placed on them.

Observational methods are used, for example, in the investigation of the behavior and mental processes of animals in comparison with each other and with man. Such work is usually referred to as belonging in the field of animal or *comparative psychology*. They are also used in the study of the development of behavior and the unfolding of mental life, called *genetic psychology*, which deals in part with the study of infants and children. In fact, direct observational methods are necessarily employed in connection with any psychological problem, for they are the necessary basis for all scientific research.

Introspection. Many psychological observations, however, have to be made of one's own mental states and processes. For example, sensations, imaginings, and the feeling of emotional reactions can be described only by the person who has them. The description of such experiences as these as they occur, is called introspection.

One may be making a judgment as to which of two lights is the brighter, or which of two weights is the heavier, in which case he is really comparing his sensations of brightness or of muscular strain. The word introspection, however, is usually used to refer to the trained subject's report, under carefully controlled conditions, of what he experiences or what he has just experienced. After being asked to depress a key, lift a weight, solve an arithmetical problem, or think of his breakfast table, he reports what happens "in his mind," what he feels, or what he sees "in his mind's eye." The following [5] is an example of introspection, though somewhat more literary than most:

> When the process is that of apprehending a sentence, I find in my own case the imagery involved is frequently constituted by a matrix of vague, shifting auditory word images, in which some significant word is likely to be most prominent, and which is accompanied by a tingling sense of irradiating meaning, which, if the sentence comes to a full stop, is likely to work itself out in associated images of a fairly definite type....

A number of introspective reports of what is called immediate experiences, under the same conditions, gives some fairly definite information concerning mental states and processes.

Introspections, however, lack *objectivity*, for the report is that of only one person on his own experience which can never be exactly repeated. Hence, when it is possible, observations are made of the action or behavior of others. For while an emotion, for example, is not the same thing to the person experiencing it as it is to the outsider observing him in an emotional state, yet such observations are more objective and more like those made in other sciences. And a great deal can be learned from a careful, scientific study of such phenomena.

Case studies Much important information may be gleaned from the prolonged study of people in their natural surroundings. Such information as the following[6] is usually obtained in a case history. identifying information, behavior for which the child is being studied, developmental history, present social environment, personality characteristics, family history, discipline, and socio-economic status. It includes, also, psychological measurements and the results of interviews with teachers, parents, psychologist, and physician. The reports obtained from children about their condition, and from other people who know them, can often be made to yield facts that explain peculiar behavior symptoms. These latter may be

indicative of mental disease or only of milder difficulties which can be cleared up by proper guidance.

The study of individual cases, however, is primarily a clinical device, though for the sake of comparison cases not needing treatment have likewise been studied. In this way it is possible to discover some of the combinations of motives that sway individuals as well as the influence of different environmental factors on their reactions.

Measurement. The great differences between people in their ways of reacting has led to the development of a number of instruments for measuring the amount of such differences. Tests of intelligence, of school achievement, and of other kinds of performance make comparisons possible between individuals and groups, and also between the earlier and later achievements of the same person, giving an indication of the amount of improvement or rate of growth or development.

Experimentation. Observation and measurement, important as they are, however, are but preliminary methods in the direction of obtaining more complete knowledge by means of experiment. Any phenomenon, whether it is physical or chemical, physiological or psychological, usually appears along with many other phenomena. Light, heat, pressure, and vibrations of the earth are but a few of the conditions which may influence physical events, while heredity, food, temperature, disease, fatigue, and the like may influence life processes. Such conditions may be present in varying amounts; hence they are called *variables*.

An experiment is an arrangement such that the influence of all variables except one is excluded, or if others are present, they appear in measurable amounts. Thus the changes in a phenomenon, whether it be that of falling bodies, disease, or learning, may be studied with respect to a *single variable* at a time. Many complicated pieces of laboratory apparatus are

designed to eliminate certain variables, and the *control groups* in biological and psychological experiments serve the same purpose. The control group is made up of subjects who are like those in the experimental group in all respects except *one*; thus any change in the experimental group which does not appear in the controls must be the effect of the one variable factor.

For example, if one wanted to find out whether instruction with the aid of motion pictures was more or less effective than the usual teaching, the single variable would be the instructional method. The experimental group would be made up of children who would see the pictures; the control group, of children who would not. The other variables would be controlled by having these two groups as much alike as possible in other respects. They should be of the same age, sex, intelligence, home background, grade in school, be taught by the same teacher, and have the same amount of previous knowledge about the unit of woık to be taught. During the course of the experiment they should have the same amount of work, exercise, and sleep.

If, then, on the test given over the same material at the close of the instruction, the experimental group does better, their superiority would be due to the instruction which included the motion pictures. Obviously, it is not easy to control all these factors, which is one reason why scientific knowledgc is obtained slowly, and why we know less than we could wish about human behavior and the workings of the mind.

Summary. In this introductory chapter, the purpose has been to indicate something of the nature of psychology as a science and its applications to education and to other fields. The pupil is an individual who comes to school with a pattern of responses already developed growing out of his hereditary

nature and his previous experiences. In school he must acquire certain skills and knowledge and learn to make social adjustments, all of which increase in complexity as he matures. The school, while cognizant of the requirements of the society in which it exists, must discover the abilities and needs of the individual pupils and seek to adapt its curriculum and instructional methods to them.

Psychological knowledge and techniques are helpful here, as they are in the development of other fields of human relationship, notably in business and industry, in religion, art, and medicine. The techniques of psychological research may be classified as observation, introspection, case study, measurement, and experimentation, though various special methods have been developed in connection with each.

The relations of psychological knowledge and techniques to school problems is evident throughout the chapters which follow. For school procedures in respect to curriculum, method, and administration are dependent in the final analysis on the nature of the children to be educated.

QUESTIONS

1. Compare the school experiences of two children you have known who had a very different heredity and home background. Did the school meet their needs as adequately as it might have?
2. Can you recall ways in which the school you attended was particularly successful in meeting your needs? Ways in which it failed to do this?
3. What do you remember learning in school that was not a part of one of the school subjects? Did you just happen to learn it, or did the school make provision for you and other pupils to learn it?
4. What are some of the applications of physics, chemistry, and biology to medicine, agriculture, and industry?
5. What other sciences than psychology have developed knowledge, principles, or techniques which are applicable to educational problems? Where are they applicable?

6. Describe any cases you may know of in which psychological applications to the fields mentioned in this chapter have been employed.
7. Is it possible to predict what a dog will do under certain circumstances? A child? Give illustrations. To what extent do such predictions make possible the control of his behavior?

REFERENCES

Starred (*) volumes among the *References* are authoritative writings which are most interesting and readable for beginning students.

1. A. T. Poffenberger, **Applied Psychology, Its Principles and Methods.* New York, Appleton, 1927.

   The applications of psychological knowledge and techniques are here described in considerable detail, and a number of references given to the various fields where such applications have been made

2. James Mill, *Analysis of the Phenomena of the Human Mind.* London, Longmans, Green, 1878, vol. I, chap. III, p. 70.

   Mill belonged to the British Association School of Psychology. For selected passages from these writers, see Benjamin Rand, *The Classical Psychologists.* Boston, Houghton Mifflin, 1912.

3. G. J. Romanes, *Animal Intelligence.* New York, Appleton, 1883.

   Romanes was the anecdotalist *par excellence* His stories of the characteristics of animals make interesting reading.

4. Ben D. Wood, "The Major Strategy of Guidance," *Educational Record*, October, 1934, pp. 16–17.

5. J. R Angell, "Thought and Imagery," *Philos. Rev*, VI, 1897, p. 648 f. Quoted by Edward Bradford Titchener, in his *Lectures on the Experimental Psychology of the Thought Processes.* New York, Macmillan, 1909, p. 99.

   The volume of lectures presents in detail the problems and methods of the introspectionists.

6. Gardner Murphy and Friedrich Jensen, **Approaches to Personality.* New York, Coward-McCann, 1932.

   Chap. VII includes an example of a detailed case history.

**Readings in Psychology* (1935) and **Readings in Educational Psychology* (1937), both edited by Charles E. Skinner and a group of collaborators and published by Farrar and Rinehart, will be mentioned as reference material at the close of the succeeding chapters. For the introductory chapter see· *Readings in Psychology*, I, II, and III, and *Readings in Educational Psychology*, I, and XXIV.

CHAPTER II

INDIVIDUAL NEEDS

Goals. When a child sees a piece of chocolate and grasps it in his hand, he is responding to a stimulus object. If he reaches for it but can't get it, he is likewise responding to it, though we say that he is trying to get it, or that he wants it, or perhaps that he needs it. He can want or need it, however, if it isn't anywhere in sight. Much of a child's behavior, or an adult's, for that matter, can be understood only in the light of a knowledge of his wants and needs, of the goals he is seeking to attain. Some of the objects he can see and touch are stimuli to which he responds in certain ways because to do so brings him to his goal.

1. UNLEARNED BEHAVIOR

Response. One of the fundamental characteristics of living things is the capacity for movement. Man is capable of a great many kinds of movement, but the particular response he will make at a particular time depends on (1) his nature, that is, on the kind of person he is, (2) his condition at the time, and (3) certain parts or a combination of parts of the environment.

Thus, in the first case, a man may open a newspaper to the political news, the sport page, the obituaries, or the "funnies." In the second case, if he is hungry, he may respond to a restaurant sign by entering the restaurant, if he is not, he may do no more than glance at the sign. Likewise, if a child is interested, he may listen to what the teacher is saying and do the work expected of him. In the third case, the sections

of the newspaper, the restaurant sign, or the words of the teacher are selected from the large number of stimuli that might be responded to.

Some responses involve the whole organism, others affect primarily only a part, as when a person blinks his eyes, turns his head, or draws away his hand, though even here more of the organism is involved than seems to be. In either case, however, there is some change in the activity of the organism, and any such change is a response.

Stimulus. The part of the environment to which the individual responds is the stimulus. The flash of light which causes the blinking, the noise toward which a person turns his head, or the electric shock from which he draws away his hand, and the newspaper or restaurant sign which he reads, are stimuli, as are also certain internal conditions like a pain. Exact usage limits the meaning of a stimulus to physical forces, like the vibrations of light and sound as they affect the eye or ear. But generally speaking, any object or event, singly or in combination, to which a living organism responds is a stimulus. Sometimes the term stimulus object or stimulus situation is used to imply a complex of stimuli.

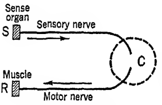

FIG. 1. THE STIMULUS-RESPONSE ARC

The responses which an individual will make to different stimuli are sometimes predictable, as in the case of winking when a light is flashed into the eyes. But in most cases there is a great deal of uncertainty. Many practical difficulties arise in connection with the educational problem of presenting those stimuli to children which will call out the responses which are desired.

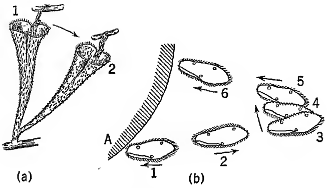

FIG. 2. RESPONSES OF UNICELLULAR ORGANISMS[1]

a. Approach Response of *Stentor* 1 is the original position and 2 shows *Stentor* bending over to remain in contact with a shred of débris which is pulled by the experimenter to the right

b Avoiding and Approach Reactions of Paramecium. *A* is a solid object or other source of stimulation; 1–6 are successive positions occupied by the animal

If the response of an organism to a stimulus is simplified diagrammatically, it may be represented as in Fig. 1, in which *S* stands for the stimulus such as light, sound, irritation of the skin, or the like, *C* for the center (spinal cord and brain), and *R* for the response of muscles or glands. Even in the simpler forms of life such responses may be easily observed. In the case of *Stentor*, a microscopic, single-celled animal, if ink is dropped into the water, the petal-like structure closes. If this is repeated several times, *Stentor* pulls its stem loose from its fastenings and floats away to fasten itself elsewhere. Similarly, *Paramecium*, a free-swimming, microscopic, unicellular organism, will back away from a drop of hydrochloric acid in the water, whereas a drop of beef extract will produce an opposite type of response bringing the animal in closer contact with the stimulus object (Fig. 2).

Approach and avoidance While the behavior of the higher

animals and man is much more complicated than that of single-celled creatures, much of it may be classified under one or the other of two easily observed types of responses — approach and avoidance. Children and adults go towards, run after, or seek to obtain certain rewards, things they may be interested in or enjoy, like candy, toys, games, money, and so on. These are said to have a *positive valence*. But they go away from or seek to escape other things — punishments, what they dislike, or what they are not interested in, like pain, confinement, boredom, fatiguing tasks, and so on. These are said to have a *negative valence*.

Drive. From the dynamic[2] point of view, an organism has energy to do things. Man and animals alike obtain this energy not from some outside power plant but from the food they eat, which gives off energy in the process of metabolism. The energy is stored in the body tissues and released by various kinds of stimulation. The energy released in this way is the drive which makes the organisms go.

Certain localizable conditions within the organism are particularly effective in releasing energy. One of these results from food deprivation, and hunger is thus a basic organic drive or "urge" which starts food-seeking activities.

There are other basic organic drives besides hunger, one of the strongest of which is the sex drive. Like hunger, it is stronger at certain times than at others, particularly in the case of animals. Other drives which have been listed are: thirst, "air hunger," the maternal drive (to keep possession of and suckle the young), the deprivation demands of the organism for rest and sleep, and for moderate temperature (avoidance of heat and cold), the excretory drives, and certain rather definite aversions like flight (fear) and attack (anger or pugnacity).

Instinct. The term "instinct" has been employed rather

loosely to refer to various kinds of behavior, the chief characteristic of which is that it is unlearned in contrast with skills and habits, which are acquired. In fact, the adjective form "instinctive," is practically synonymous with *unlearned*. The characteristic behavior connected with the operation of organic drives is in part instinctive, though the means employed to satisfy them adequately, particularly in man, are of course acquired. Thus, for example, one may learn a trade, learn how and what food to buy with the money thus earned, and learn the accepted ways of preparing the food and getting it from the table to one's mouth — all in the satisfaction of the hunger drive.

There have been many classifications of unlearned behavior,[3] of which the list of organic urges or drives is but one. A second includes what may be called unlearned *patterns of behavior*, such as those which are easily recognized in animals, like pouncing on prey, tree-climbing, burrowing, spinning (in the case of spiders), nest-building, hoarding, preening, fighting, escaping, curiosity behavior, and many others. Such a list includes drives, behavior patterns, and activity seemingly directed to some end, and mixes learned and unlearned factors indiscriminately. This confusion is largely responsible for the dropping out of the word "instinct" from modern psychology. Its usefulness consists only in the grouping of tendencies so as to emphasize the unlearned factor.

A third kind of classification of unlearned behavior looks to the *ultimate goal* or end of a series of responses. Such a classification includes self-preservation, perpetuation of the species (sex), and of the social group (herd instinct or gregariousness). There are two chief difficulties in such all-inclusive terms. One is that each embraces a great many kinds of behavior and a great many kinds of drives. The other is that in all probability the individual isn't really trying to do the things in-

dicated but, instead, is just responding in such ways as he is able to the different stimuli that present themselves. Most of his responses have the ultimate beneficent results described, but not all of them. Such a classification based on ends to be achieved is called a *teleological* classification.

Satisfiers and annoyers. A fourth kind of classification is one based on the stimuli which may call out the approach or avoidance responses. Thus one would have a list[4] of such things as sweet tastes, pleasant odors, creatures of the same species of opposite sex, and of bitter tastes, nauseating odors, intense or painful stimuli, and the like.

Such a classification, if it could be made complete, would have the advantage of being practical. It could be used to get desired responses. But the trouble is that there are so many satisfying and annoying things and so many ways to respond to them. Food, for example, even when one is reasonably hungry, does not necessarily stimulate action toward it unless it has certain characteristics of appearance, taste, odor, temperature, and consistency. And the same is true to a greater or less extent of all the other objects to which animal or man can respond.

There is a way to simplify this classification by saying that organisms tend to approach, want, or desire what is *pleasant,* and on the opposite side, that they tend to avoid or escape what is *unpleasant.* Such a view is called *hedonistic.* A thoroughgoing hedonist even contends that right and wrong are determined by pleasantness and unpleasantness. It would, of course, be futile to deny that man is guided to a considerable extent by these considerations.

However, there are so many cases where the seemingly unpleasant is sought and the pleasant avoided that the hedonistic principle is unsatisfactory. Furthermore, we do not know, in the case of animals, what is pleasant to them and

what is unpleasant. All we know is the way they behave. Objects which animals and man tend to approach have been called satisfiers or satisfying states of affairs. Similarly the objects or conditions they tend to avoid have been called annoyers or annoying states of affairs.

2. NEEDS

Food, clothing, and shelter. Biologically viewed, the organism must have certain things if it is to survive, or if it is to continue in a healthy condition. A number of these, so far as they are needed by human beings, have been classed for convenience under the head of food, clothing, and shelter. They include air, water, food, moderate temperature, light, rest, and sleep — the satisfaction of the basic organic drives. The school, as a social institution, provides its pupils with some of them, leaving it to the families concerned to furnish the rest. The result has been satisfactory for the most part, though the inequalities which exist are the cause of some of the most serious school problems.

Activity. Some other needs are almost as certain in their operation. One of these is the need for activity, as shown by the fact that unused muscles tend to waste away or atrophy. An older and more rigid type of school discipline which compelled pupils to sit quietly in their seats was thus working against nature. In contrast there have developed what are known as "activity programs" in which it is sought to direct the normal activity of children into educational channels. In addition to greater freedom of movement and expression in connection with regular class work, most schools have now developed a broader program of physical education, and some have added hikes and excursions.

Effective effort. It should be emphasized, however, that

mere activity is hardly satisfying — it must be directed toward some end, toward winning a game, or completing a task. Indeed, some[5] who deal with children's problems have averred that basic and necessary satisfaction with life is obtained by one who has a *task* to perform, providing he has a *plan* for accomplishing it and *freedom* to go ahead with it.

These three conditions — a task, plan, and freedom — are to be found in games of skill, and also in educational projects. The project idea has developed in connection with shop and laboratory work, and has expanded to include a complete reorganization of subject matter. Instead of following the logical organization of separate school subjects, the project method often cuts across these somewhat artificial boundaries and follows the developing interests of children, for the self-imposed task is usually more satisfying than one imposed by someone else

Thus a ship project leads from the construction of ship models to a discovery of trade routes, and from the historical study of the evolution of shipbuilding to a consideration of products, tariffs, and imperialism. Or a circus project, involving the work of every department of the elementary school in its preparation, eventuates in a pageant for parents and friends.

Beauty. Few would deny the prime necessity of food, clothing, and shelter, or of physical activity involving effective effort. Yet some might question the existence of a basic psychological need for beauty. The elements of beauty, however — rhythm and pattern in movement and sound, and in form and color, and the symbolic representation of ideas and emotions — are as fundamental in man's organization as breathing. They enter into various forms of religious expression, into his amusements, and into his everyday activities, and they are found in his quest for orderliness in the world through his mathematical and scientific formulations.

It is on the theory of a basic need for beauty, in both its appreciative and its creative aspects, that sordid and barren environments are replaced by school structures more attractive within and without, that opportunities for artistic experience are brought to the children through literature, painting, and music, and that pupils are allowed to express themselves in rhythm, color, verse, and melody.

Sex. There is much evidence supporting the view that artistic expression is closely related to sex. This evidence ranges all the way from the coloration and songs of birds in the mating season to the love lyrics of adolescence. The sensuous verges close upon the sensual, while love and beauty are linked in countless ways.

Be that as it may, the force of the sex drive has been sung in story and verse and demonstrated by experience and experiment. Equivalent to hunger in that an inner condition seeks an outer satisfaction, it is further complicated by archaic tabus, moral sanctions, social customs, religious scruples, and legal regulations.

There are four main reasons for all this complexity: the danger of venereal disease, the seriousness of the responsibility for children, the inheritance of property, and the loss of what for want of a better name can be called spiritual values through excess. Whatever the conflicting ideas of different individuals or groups may be concerning the propriety of expressions of affection on various occasions, one or more of these four reasons are in the background.

The older view of sex education, namely, withholding all information, is gradually being displaced by one of enlightenment. Parents are urged to break the "conspiracy of silence," and furnish correct information — not necessarily all in a lump, but as it is sought, and instruction in sex hygiene has found a place in many schools. Certainly much harm is done and

many useless fears are encouraged by forced ignorance or incorrect infoimation.

If a school gives instruction in sex hygiene, however, it fulfills only a part of its function in this particular. Provision should be made for natural relationships of boys and girls in work and play, and for sympathetic discussion of individual pupil problems and difficulties. While a wise and sympathetic teacher can help a little in the amorous entanglements of youth, they are all too apt to be mishandled, for there are few if any rules for his guidance.

Security. The assurance of sufficient food, clothing, and shelter is generally regarded as security for adults, but for children secuiity is a little more than this. It is the assurance that he can go to certain persons under any and all circumstances, and be sure of protection, sympathy, and guidance. Normally, such security is furnished by the home, and when it is not, as in the case of drunken, debauched, or brutal parents, the child's school adjustment is all the more difficult.

It is not easy for a large departmentalized school to satisfy the pupil's need for security. He goes from one teacher to another, perhaps gets scolded by each in turn, and rebels against the institution. Perhaps he decides it would be wiser not to go any more; but truancy only leads to more trouble. If he is fortunate, he may find the security he craves in some crowd or gang, or in the friendliness and sympathy of an older pupil or home-room teacher.

Prestige. Few children — or adults either, for that matter — can get along without at least a modicum of *recognition* of themselves as persons by those about them. This has been called "the wish for worth," and is to be noted in such simple things as wanting to be called by one's name, and expecting courteous treatment from one's fellows. It is satisfied in various ways: by the acquisition and display of wealth, by

honorary degrees, badges, and decorations, by membership in recognized clubs, by news items or other forms of publicity, or by a reputation for skill or learning.

Similar agencies of recognition function on the child's level. The democratic school frowns on personal ostentation and display, but for them it substitutes a system of marks and honors. Pre-eminence in sports, in school and class organizations, and in other activities including the various hobby clubs also operates to satisfy the need for social recognition. "You have got to be able to do something, if it is no more than play a banjo and twirl it around between plunks," urged a youthful magazine-story heroine, and her somewhat bashful and retiring friend got the idea.

It would be possible to make a prestige scale beginning with the zero point of neglect and running up through companionship, security, and social recognition, to leadership, power, and domination. One can name individuals who, in respect to various groups, are at each of the different points of the scale. Some children, perhaps because of physical or social handicaps or personal unattractiveness, are forgotten or just endured. At the other extreme are those who, because of their emotional outbursts or perhaps an enfeebled physical condition, are virtual tyrants in their homes. The school should seek to provide an opportunity for each and every pupil, by some means or other, to gain a fair amount of social recognition.

The power goal has been magnified by some, especially by Alfred Adler,[6] to embrace practically all the ends for which man strives. Thus, the satisfaction of the biological needs is the seeking of power over nature — over life and death, so to speak. Love consists of gaining power over the loved one, and all effort or desire for recognition is merely the quest for power over one's environment or one's fellows.

There is, of course, an element of truth in this extreme view.

Even the very humble may be accused of using their humility to gain their own ends. And at the other extreme are those in whom the lust for power stops at nothing in the attainment of their goal, whether their tyranny is maintained by military or economic means or both.

Teachers or children who tyrannize over other children are not popular, and are usually trying excessively hard for recognition and prestige — so hard that they over-reach themselves. The tyrannical and exacting teacher has been called a martinet, and is a joke in his petty domain to all except those over whom he wields his power. The tyrannical child or "bully" needs guidance of his misdirected efforts to obtain the recognition and power he craves.

Service. In contrast with man's craving to dominate over his fellows is the contrary need to be of service to them. In a number of situations[7] involving the opportunity to do things for others, children showed wide differences in the amount of their service behavior. It was found that a team organization aroused more unselfish loyalty than an ordinary classroom control group operating in the same experiment. Other factors influencing service behavior favorably were the mutual friendship of children in the same classroom, the type of home from which they came, and satisfactory school adjustment.

Older children often make better social adjustments if they have some responsibility for younger children. Even a boy's devotion to his dog, punctuated though it may be by occasional forgetfulness at feeding time, represents the satisfaction of a basic need. And the helpfulness which those taking an examination sometimes show each other suggests that there is a dearth of opportunity for the mutual aid which the project method provides.

3. MOTIVATION

The satisfaction of needs. The following individual human needs have been briefly described: the need for (1) food, clothing and shelter, (2) activity, (3) effective effort, (4) beauty, (5) sex, (6) security, (7) prestige, and (8) service. While various modifications could be made in the list presented, these needs have motivating force wherever human beings are found, whether one studies primitive tribes, or civilized nations, employers or workers, adults or children. Political and social organizations are maintained to supply them, and the schools cooperate with parents, welfare agencies, and other institutions that children may not be deprived of them.

Of course, the question is not entirely one of complete deprivation of any of them, which would be likely to result in death or perhaps insanity. It is rather one of deficiency, or of the attainment of proper amounts. Children need food, but they need enough food of good quality; they need pure air and water, sufficient activity, worthwhile and appealing tasks, and so on. To provide these in the right amounts to satisfy the needs of individual children as they mature is one of the continuing problems of education.

One of the many difficulties in adapting the schools to the needs of children is that the individual may not know exactly what it is that he needs. Even adults may confuse such basic, biological needs as those for rest and for food, and a person may cast about, following one desire after another without satisfaction. Thus dinners, parties, sport, or travel may be desired; but work, responsibility, or, to use a hackneyed phrase, service to one's fellow men may be needed. Or it may be the other way around. A well-balanced life reaches out after many satisfactions, but follows none to excess, though devotion to a cause, altruistic, religious, or patriotic, gives to many a

direction or *orientation* in life which is fundamentally satisfying.

Wants. The term wants, while it is sometimes used to mean either organic drives or needs or both, is best applied to the desire on the part of the individual for specific things, which may be a means of satisfying these drives or needs. Thus a child may want lettuce but not spinach; he may want some roller skates at one time and a football at another; he may want to ride in a boat, to play baseball, or go to a party.

The particular wants of children are often indicators of their needs, but they are sometimes not the best means of satisfying them because of the element of danger, or harm, or perhaps the inconvenience of adults. In some cases *substitution* is effective, as when a small child wants to cut with sharp-pointed scissors and blunt ones may be just as acceptable. Sometimes a *promise* is a satisfactory solution. "You may have the candy at dinner," or "You may play with the blocks after you have had your rest." Sometime, however, the child will have to discover that he can't have or do everything he wants.

Similar difficulties present themselves when a child does not want to do what for some reason or other is deemed necessary. In such cases it is perhaps well to consider rather carefully whether it really is necessary. If it passes this test, there are many forms of reward and punishment, none of them any too satisfactory, to motivate him and bring about the desired response.

Goal-seeking. If a child is confronted with the proper object or situation, approach behavior is quite unmistakable whatever the need it satisfies. A small child may be placed on the floor at a little distance from such an object, which serves as an incentive, a lure, such as a piece of candy, a doll, or some toy. His movement toward it may be diagrammed as in Fig. 3. The incentive (*I*) has a positive valence (*V*) in the direction

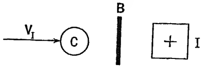

FIG. 3. POSITIVE VALENCE [8]

indicated by the arrow. The child (*C*) wants what is before him and moves toward it. Its successful attainment results in satisfaction, that is, he gets what he goes after. This is the first of three logical possibilities which follow from the existence of a want or need.

Incentives and deterrents. In general, incentives are objects or states of affairs which individuals want, or which will satisfy their needs. The money incentive, which is so omnipresent, is a symbolic one, in that money stands for or makes available a large number of satisfactions. Schools cannot use this, except as a promised reward for faithful work after school days are over, and in fact they may not employ any of the basic organic drives as incentives or rewards. But there are a number of incentives left to them which are to a greater or lesser degree satisfying, the most frequently used being good marks and praise, which combine the satisfaction of the need for effective effort and prestige.

But the path to the incentive, to the attainment of the goal may not be open. There may be some *barrier* in the way which must be circumvented if success is to be achieved. Barriers (*B* in Fig. 3) are of various sorts. They may be physical objects, like a couch placed between the child and the incentive; or they may be fences, walls, rivers, or mountains between the individual and his goal. They may also be school examinations, eligibility requirements, or the opposition, interference, or demands of other individuals or groups Or, viewed the other way around, the barrier may be thought of as the in-

dividual's lack of strength, training, or skill, or his stupidity or incompetence, which interferes with his progress toward his goal in the satisfaction of his needs.

In any case, the barrier is an object or condition which blocks or thwarts the individual in the attainment of his goal or reward. Such *thwarting* is the second logical consequence of the existence of wants or needs. It may serve as a challenge, or it may cause defeat.

Instead of an incentive stimulating approach behavior, there may be a deterrent in the path, an annoyer, some object calling out avoidance reactions in the organism, such, for example, as a barking dog in front of a small child, in which case the valence is negative as in Fig. 4. Many are the annoyances which people try to avoid. One investigator[9] made a collection of twenty-one thousand of them including mice, gum-chewing people, bad breath, and adults talking baby talk.

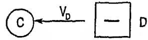

FIG. 4. NEGATIVE VALENCE

Many tasks are also sufficiently unpleasant to produce a negative valence, though ideally a task should have a positive valence, so that the doing of it is its own reward. But schools are notorious for their discovery of unpleasant tasks, which adults think are needful for the well-being of the pupils. And they are adept at designing conditions, called punishments, which are so unpleasant that the task becomes attractive by comparison, whether the punishment is corporal, a deprivation of privileges, or some other disciplinary measure. The situation is such that the avoidance of the punishment is in reality a reward for performing the task. Both the task (T) and the punishment (P) act as deterrents, having a negative valence, as in Fig 5. But if the punishment is to be effective, it must have a stronger valence than the task.

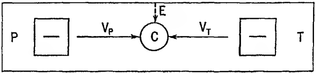

FIG. 5 PUNISHMENT AND TASK

When the school employs a system of rewards or incentives, the child is thwarted by the task, which stands like a barrier between him and his reward, as in Fig. 6.

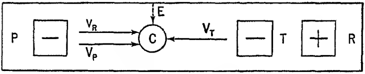

FIG. 6. REWARD AND TASK

If a combined system of rewards and punishments is in operation, like good and poor marks, for example, both tend to compel the child to perform the task by strengthening the valence in its direction.

Conflict and escape. It will be noted in Figs. 5 and 6, above, that the child is being driven in two directions at the same time. This is a conflict situation, and *conflict* is the third logical consequence of the existence of needs. A conflict is apt to result in the child's moving in such a way as to escape from the field of forces which are playing upon him, as indicated by the dotted arrows in Figs. 5 and 6. He may seek to avoid both the task and the punishment by running away from school. And investigations have shown that this is the cause of most truancy. Schools therefore set up barriers which completely surround the child, the task and the punishment (represented by the rectangles in Figs. 5 and 6), which serve to keep him from escaping. In reality these barriers are such things as walls of

school buildings and closed doors, or they may be roll calls, rules and regulations, or perhaps the influence of the teacher or parent. If these prove effective, and the conflict continues, other forms of escape may be indulged in. These will be described in the next two chapters.

Summary. Approach and avoidance responses to external and internal stimuli may be observed at all levels of development from the single-celled creatures to man. Unlearned tendencies to respond in certain characteristic ways have been called instincts, drives, and urges, and have been variously classified. Basically, however, organisms have certain needs, deprivation in whole or in part results in death or underdevelopment of some sort, their proper satisfaction results in a more abundant life. One of the school's most important tasks is to furnish guidance to pupils in the discovery of their needs and in satisfying them wisely. Some school tasks, supposedly directed to this end, result in approach responses — they have a definite drawing power or positive valence. Others are avoided, having a negative valence. They act as barriers to the individual, thwarting him in the attainment of whatever rewards are offered. Other barriers enclosing the child likewise thwart him in the attainment of his goal, with the result that conflict develops through the opposition of valence induced by punishments and rewards, so that if conflict continues various forms of escape may be tried.

QUESTIONS

1. Give as accurate a description as you can of what some pet animal does when motivated by the hunger drive.
2. Describe some of the behavior which is learned and becomes habitual for human beings in connection with some of the basic organic drives.
3. Why is "instinct" an unsatisfactory term in psychology?

4. List some of your own personal satisfiers and annoyers.
5. What are some unpleasant things that are sought, and some pleasant ones that are avoided?
6. What opportunities do modern schools offer foı the satisfaction of each of the basic needs? What improvements can you suggest?
7. Give illustrations of substitutions and promises which you think would be effective in dealing with the wants of children on the elementary school level, on the high school level, in dealing with adults.
8. In your case do you consider praıse or blame more effective motivation?
9. How do you react when you are thwarted?

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CHAPTER III

EMOTION

Satisfaction. When an individual obtains what he wants or needs, the action is completed so far as that experience is concerned. The tension of the drive is released, and a state results which has variously been called satisfaction, complacency, or equilibrium. Thus a child who has just eaten ceases to strive for food, and one who has been scrambling toward and reaching for a toy may sit down contentedly and play with it. Of course, such a state of contentment does not last long. The rhythmic organic drives soon make themselves felt again, and other things will be wanted or needed. Satisfaction is a continuing process.

I. EMOTIONAL RESPONSES

Emotion and thwarting. In the case of the child crawling along on the floor toward some stimulus or goal object, however, if the object is removed, or if he cannot go around the barrier which separates him from it, he is apt to respond by crying. This infantile response to thwarting is familiar when a baby loses his bottle, when a small child cannot reach the toy outside his pen, or when he can't find his mother.

In adults the same infantile emotional response to thwarting may occur in just as simple and direct a fashion, though it may be disguised in various ways, and a variety of situations may call it out. In its milder form it may be but a temporary feeling of annoyance, as when one comes to a detour sign, or strikes the wrong key in typing. Or it may be more intense, as when a student fails an important examination, or is thwarted in his

play or work activities by a parent or teacher, or when a young man is blocked in his professional advancement by scheming adversaries.

The person who thus interferes is an object of *dislike* or *hate*, according to the importance of the situation, while the one who furthers, supports, or cooperates with the individual in gaining his ends is *tolerated*, *liked*, or *loved* according to the circumstances. The varying characteristics of people, however, and the complexity of desires and environmental conditions, permit strange mixtures of these opposing emotions.

Many emotional states are aroused, not by actual interference in a course of action, but by anticipation. One foresees approaching disaster. Then, too, after the interference has occurred, one may continue in an emotional state. The nature of such retrospective emotion depends on the individual's past success or failure in meeting the situation. Its intensity depends on the significance of the need to the individual and the consequences of success or failure.

The schemes for the classification of emotion are numerous, but the following may have some practical value:

Prospective	*Immediate*	*Retrospective*	*Personal*
enthusiasm	thrill, excitement	elation	love, devotion
confidence	anger, rage	joy	liking
faith, hope	startle, annoyance	satisfaction	toleration
worry	shyness	disappointment	dislike
anxiety	fear	regret, sorrow	aversion
despair	terror	grief, anguish	hatred

Above the line, success is anticipated, assured, or achieved, while below the line failure is anticipated, assumed, or experienced. The distance above or below the line roughly indicates the degrees of intensity of the emotional experience. The positive emotional attitudes primarily directed towards persons are above the line, the negative below.

Emotion as conscious experience. Introspective reports are the only source of information concerning the nature of emotion as a conscious experience, that is, from the *subjective* point of view. And such reports are quite unsatisfactory because descriptive words and phrases must be interpreted by another individual in terms of the latter's emotional life. However, emotion subjectively viewed may be described as a complex *affective* experience. It is complex in that the whole individual seems to be involved and not just a localizable part as when one has an ache or a pain. And it is affective in that feelings of pleasantness and unpleasantness are an important part of it.

If it were not for emotional experience, life would be rather mechanical and drab to the person living it. The thrill of success and even of uncertainty, disappointment, and failure gives a richness and color to human existence that few would care to do without, while the artistically portrayed struggles of others as experienced by proxy in literature and drama satisfy a basic human need.

Emotion as diffuse response. As viewed in *another* person, emotions are complicated bodily movement patterns, the outward manifestations of which are laughing, crying, blushing, jumping up and down, changes in facial expression and posture, and the like. From this *objective* point of view, emotion may be described as a complex, stirred-up state of the organism, characterized by more or less definite patterns of response.

The relationship between emotion as conscious experience and as response pattern was clarified some years ago by a theory propounded independently by William James,[1] an American psychologist, and Carl Lange,[2] a Danish physician, and hence called the *James-Lange theory* of emotion. The view previously held was that some vaguely defined quality, called emotion, which is aroused after the stimulus object is perceived, produces the emotional response. According to the

James-Lange theory, however, the stimulus produces motor responses directly in the usual way, and the sensations and feelings aroused by these responses *are* the emotion. Thus the sensations and feelings aroused by trembling and crying are the conscious emotional experience of fear and grief respectively. James held that without these conscious experiences produced by bodily reverberations there would be no emotion, only cold, rational understanding of the situation. The theory has had its supporters and its opponents — later evidence seeming somewhat equivocal with respect to it.

Judging emotion in others. Facial expressions, gestures, and posture supposedly indicate something of the nature of the emotion an individual is experiencing, and a number of experimental studies[3] have sought to discover the extent to which such movements are correctly interpreted. The usual method is to take pictures (either stills or movies) of persons who are portraying certain emotions and then present these pictures to different groups, and ask them to indicate the emotion portrayed. Although older children are more often correct than younger in naming the emotion intended, egregious errors are made at all ages, some observers even confusing grief and anger.

Such confusions may mean that the actor either doesn't portray the emotion as the observer knows it, or doesn't portray it correctly, or both. In fact a careful study of the facial muscles has shown that many of the same movements occur when the subjects report different emotional experiences. Furthermore, no physiologically different conditions have as yet been discovered as characterizing different emotional states.

Judgments as to whether a person is happy, angry, or sad, and so on, are seemingly based only in part on interpretations of his involuntary facial movements and gestures, and in

large measure on what he does and says in various social situations, as well as on the stimuli producing the emotional responses.

In the adult, the interplay of emotion and situation is so complex that great difficulty might be expected in differentiating the responses. Some years ago, John B. Watson,[4] on the basis of his experiments with infants, announced his discovery of the three basic emotions, fear, rage, and love. He described the situations giving rise to these emotions and the responses that occurred in each case.

However, later studies,[5] in which motion pictures were taken, have shown that when infants were stimulated by food deprivation (hunger), sudden loss of support ("fear stimulus"), restraining the head and face ("rage stimulus"), and by being pricked with a needle (pain), supposedly qualified judges were quite unable to agree on what emotion was being evoked if they did not know the stimulus situation giving rise to it.

Thus the emotional responses to thwarting, what may be called unpleasant emotions, in some cases at least are objectively practically indistinguishable, though there is little doubt they are quite different from those arising from the satisfaction of desires or needs, as illustrated by the so-called love responses of Watson's experiments — smiling, gurgling, cooing, and the like.

2. THE AUTONOMIC NERVOUS SYSTEM

The cranio-sacral segment. In recent years, studies of the autonomic nervous system[6] and of the ductless glands have given a better understanding of the physiological mechanism underlying emotion. The autonomic system, as its name implies, operates independently of voluntary control. It is made up of the nerves connecting with the smooth muscles and glands

involving such organic activities as respiration, circulation, and digestion.

But since these are some of the very activities that undergo a change in emotional excitement — quick or labored breathing, blushing, dry mouth, etc., it seems reasonable to suppose that there is a connection between the action of the autonomic system and the diffuse emotional responses. And such proves to be the case.

The autonomic nervous system is made up of two parts, the sympathetic (or thoracico-lumbar) segment connecting with the central portion of the spinal column, and the parasympathetic (or cranio-sacral) segment connecting with the upper and lower portions. The cranial division at the upper end, including various cranial nerves, connects the brain stem with the iris muscle, causing it to contract, and with the salivary glands, producing a secretion of saliva. Other fibers connect with the muscles and glands of the stomach and intestinal tract, which further the digestive processes, and with the heart, tending to slow down its beat. The sacral division, at the lower end, connects the spinal cord with the genital system and with the retaining muscles of the bladder and colon.

The cranio-sacral segment is thus seen to be rather definitely *physiological*, the responses for which it is responsible are quite *specific*, and all contribute to body *conserving* and *upbuilding*.

The sympathetic segment. The action of the muscles innervated by the sympathetic segment of the autonomic nervous system is opposite or *antagonistic* to that of the cranio-sacral. Along the spinal column within the body cavity is a row of nerve cell clusters or *ganglia*. These ganglia are connected with the spinal cord by what are called preganglionic fibers. From each ganglion, postganglionic fibers extend to various muscles and glands, many of them being the same as those also innervated by the cranio-sacral segment.

They cause the iris (hence the pupil) to widen, the lachrimal glands to secrete tears, the salivary and digestive glands and the muscles of the stomach and intestines to inhibit their digestive functioning, the bladder and colon muscles to discharge, the hair (or goose pimples) to rise, and the sweat glands to exude their product on the body surface

Many of these responses are described by writers in various ways to reveal the emotional stresses of their characters and are portrayed, sometimes in exaggerated form, on the stage and screen. The "cold sweat" of many a juvenile hero has even been used in scientific studies of emotion. A galvanometer connected with electrodes on the skin surfaces registers changes in the electrical conduction of the body. The *psycho-galvanic* or *skin reflex*, as such a change is called, has been tested in connection with the association experiment. When the subject is asked to respond with the first word he thinks of to the words like "love," "girl," "name," and so on, which supposedly have emotional significance, the responses are much stronger than when such words as "house," "chair," and "tree" are used. Changes in heart or respiration rate are also found as further evidence of the activity of the sympathetic nervous system.

The emergency theory. Still more order in these somewhat unconnected functions is tentatively established by Cannon's emergency theory of the emotions. According to this theory, the sympathetic system operates in a physical emergency to strengthen the body for combat or other unusual exertion.

Accelerated heart action drives the blood more rapidly through the blood vessels, thus washing away the fatigue products more effectively. In addition, the blood is diverted from the digestive tract, the action of which is inhibited, so the skeletal muscles are better provided for. The liver discharges more sugar, which gives greater strength, and the adrenal gland secretes adrenin, which produces similar effects and like-

wise increases the rapidity of the coagulation of the blood, a factor which may prove useful if the individual is wounded

The theory seems most complete, and accounts for the oft-reported increased strength or "second wind" in times of stress.[7] It also shows a reason why physical exercise immediately after eating is undesirable. For it is then that the digestive processes are requiring a full supply of blood, and when the shunting off of the cranio-sacral segment and its replacement by the sympathetic segment would leave the food half digested, a condition which is inimical to the best physical well-being.

A theory of the emotions derived from such nicely coordinated physiological activity would seem to be in opposition with the statement made earlier that emotion is a diffuse and disruptive response. But the very term "emergency" implies a rather vigorous thwarting of the individual in the normal course of his activity. The result is a new coordination involving complex bodily changes to meet the emergency. If added physical strength and endurance are what is required, the outcome may be successful. If delicate coordination or a wise choice of means to obtain desired ends is a requisite, the overwhelming responses occasioned by the activity of the autonomic nervous system are more apt to spell disaster. They may be a help in overcoming or escaping from an assailant, but they would be far from effective in mending a watch or planning an experiment.

3. THE ENDOCRINES

The ductless glands and emotion. It may be seen from the description of the action of the autonomic nervous system that emotionality is not just imagination, but a matter of flesh and blood, of nerves and muscles and glands. The salivary, lachri-

mal, and sweat glands, which were mentioned, are duct glands, so-called because they discharge their product through little tubes or ducts upon the surface of the body.

Ductless glands or endocrines are in a different category, for their product is discharged directly into the blood stream through the walls of blood vessels which interpenetrate the glands. Some of the most spectacular scientific work in recent years has been done in this field,[8] but much remains yet to be discovered. It is clear, however, that while some of them are narrowly physiological in function, like the parathyroids, the thymus, and the pancreas, the activity of others has a definite bearing upon psychological problems, and more particularly upon the nature of emotional experiences. Of these latter, the adrenal, thyroid, and pituitary glands, and the gonads or sex glands are psychologically the most significant.

The adrenal glands. The adrenal or suprarenal glands, as they are sometimes called, are two in number, one fitting somewhat like a cocked hat over the upper part of each kidney, and together they weigh only a little more than a quarter of an ounce. They are of a fatlike color, and each is made up of a central core or *medulla* and a surrounding bark or cover called the *cortex.* Innervated by the autonomic nervous system, the adrenal medulla is in a way a sympathetic ganglion; and its secretion, or *hormone,* has the same effect on the body as the sympathetic segment itself, serving to reinforce and prolong its activity.

The hormone of the adrenal medulla is *epinephrine,* also called adrenin and adrenalin. This substance increases the rapidity of the coagulation of the blood and increases the capacity of a fatigued muscle for work. Its surgical value and its use as a stimulant are therefore very important, as is its part in emotional responses.

The hormone of the adrenal cortex, called *cortin,* is necessary

to life, while a deficiency results in what is known as Addison's disease. Overactivity of the cortex results in an increased virility or masculinity for both sexes. Sometimes it causes a rapid physiological maturing of the sex function and the growth of a beard and body hair during childhood, a condition known as *pubertas precox* or precocious puberty.

The thyroid gland. No less dramatic is the effect of the thyroid hormone, or thyroxin, which has been discovered to be 65 per cent iodin. It is secreted by the thyroid gland, which is divided into two lobes on each side of the windpipe. The isthmus connecting these is what becomes swollen in cases of endemic or colloid goiter, a condition which in America is found most frequently in the Great Lakes region. Goiter may be relieved and prevented by iodin dosage.

Thyroid deficiency (hypothyroidism) is responsible for the condition called *cretinism*, or more properly *childhood myxedema*. It is the most spectacular type of clinical feeblemindedness, and perhaps the most pathetic. The child so affected is an idiot or imbecile, dwarfed, fat, and generally undeveloped; but the condition can be overcome, if treatment is begun early enough, by continued doses of thyroxin. A less marked thyroid deficiency is undoubtedly the cause of some cases of school retardation and physical sluggishness so that school physicians, by prescribing thyroxin to such cases, can aid them materially.

Myxedema in adults, which is more common in women than in men, is recognized by an increased sensitivity to cold, a lowered basal metabolic rate, and a tendency toward obesity. In more extreme cases depressed moods, confused states of mind, and symptoms of mental disease are found.

Overactivity of the thyroid (hyperthyroidism) results in a general speeding up of the metabolism of the body analogous to the effect produced on a fire by opening the draughts. It is interesting that tadpoles fed with thyroid extract turn into

frogs almost at once, though they may be as small as flies; while if their thyroid glands are partly removed, they remain tadpoles, though they may grow as large as frogs. A Mexican salamander was always a gill-breathing animal, mature at the tadpole stage. But thyroid substance makes him an air-breathing, land animal.

A patient suffering from overactivity of the thyroid shows an increased basal metabolic rate. His eyes seem to bulge out, giving him a startled expression. He becomes anxious, restless, and excitable, and is troubled by muscle tremors and by insomnia, sometimes developing characteristics of mental disease with mental confusion, delusions, and hallucinations.

School pupils who are characterized as nervous and high-strung, excitable, or emotional, are quite apt to be suffering from a mild form of hyperthyroidism. There is no specific cure. Rest is helpful, as is iodin treatment (administered by a qualified physician), while in extreme cases a part of the thyroid is removed surgically to reduce the amount of thyroxin secreted.

The gonads. The male and female sex glands, the testes and ovaries, have a twofold function, one of which is reproduction. It is with the other function, operating through the internal secretion of these glands with which we are concerned here.

The gonads have been known since the earliest antiquity to have an important influence upon the physical and psychic growth of the individual Castration of the stallion and bull produces the more amenable horse and ox, respectively. The same operation has been performed on boys in certain church choirs to preserve the treble voice, and in the Orient to develop servants, called eunuchs, who served as custodians of the harem.

The earlier claims that the sex hormone was the true "foun-

tain of youth" have proved unfounded. Various experiments have been performed, however, by injections of the sex hormones or by grafts of living glands in old or castrated animals. Some such experiments have reported at least a temporary enhancement of the sex characteristics, such, for example, as the growth of the comb and wattles of capons.

The effects in the case of human beings are not very well known because of a number of psychological and social conditions which make experimental work and the obtaining of accurate reports difficult. The virile individual presents a very different picture from that of the eunuchoid or emasculated type. But the age at which gonad deficiency occurs, the extent of the deficiency, the influence of other glands, and the psychological and social attitudes involved influence the situation in unknown ways

There are at least two female hormones, theelin and progestin, deprivation of which stops the development of normal sex characteristics and produces an underdeveloped or neutral type. In the two sexes, gonad influences upon eroticism and emotional life are comparable, though much more research is needed on this and the many other problems of the endocrinology of sex

Other ductless glands. A number of other glands are directly or indirectly of psychological importance. The *pituitary* gland or hypophysis, located in the center of the head cavity, has an *anterior lobe*, the hyperactivity of which produces giants, the tallest of whom to be recorded having attained a height of eight feet, six inches. The hypo-activity of the *posterior lobe* results in the production of fat and in sexual underdevelopment.

Another gland is the *pineal*, just back of the pituitary, and like it, attached to the under side of the brain. Little is known of its function except that it is supposed to aid in the

regulation of bodily growth and development and the oncoming of puberty.

Other hormones, insulin from the pancreas, used for the treatment of diabetes, and hormones from the liver and the intestinal tract, are of physiological and perhaps of psychological importance.

Endocrinological research. Knowledge about the hormones and their functions is extremely difficult to obtain, for a number of reasons. Surgically, they are hard to get at, their extirpation may cause death, and the operation itself may have effects which would confuse the results. Grafted glands are apt to die, the secretions may lose their potency, and are often difficult to obtain, prepare, or administer. Considerable training and skill are needed by the experimenter, as well as financial backing. Yet it is rare that researches have been so important in their results as some of those of the endocrinologists.

The most difficult hazard for experimentation to overcome, however, is that of the interaction of the various glands. If each gland acted in isolation, the task would be relatively simple As it is, the hormones operate in connection with the nervous system and also stimulate the activity of other glands, and the combined effects ramify in many directions. The pituitary and the thyroid, for example, are known to affect each other. Hence, it is most difficult to diagnose physiological conditions, and personality characteristics as due to this or that gland. Still more dubious are the enthusiastic delineations of glandular personality types, interesting though they may be for speculation.

Endocrinology in the school. In spite of the difficulties mentioned, a number of studies have reported the improvement of physical and behavior conditions of school pupils through the use of glandular extract, particularly thyroid and pituitary.

Sluggish or retarded growth processes have been thus accelerated to normal with the result that peculiarities which made adjustment difficult were removed. Following this, a kind of re-education is often necessary to help the children to form new habits, to take the place of the former unsatisfactory ones. But the work is still in the experimental stage.

4. MOOD, TEMPERAMENT, AND ATTITUDE

Mood. Emotional conditions which persist for some time are called moods. Variations in mood are usually expressed vertically, as in the old song, "I'm sometimes up and I'm sometimes down," though important qualitative differences likewise exist. A person may be temporarily depressed, "moody," complaining, and irascible, or he may be exalted, light-hearted, cheerful, and gay. In any case one can recognize in moods the traces of emotional responses to thwarting.

While external events are important in the effect they produce, individuals differ markedly in the range, intensity, and changeableness of their moods. Furthermore, the same situation may affect people differently. Some are very much depressed by thwarting and failure, while others are "thick-skinned" and "laugh it off." These facts, together with the rather striking moods of cheerfulness and depression which characterize certain types of insane patients with no apparent external cause, suggest that the condition is due in large measure to internal organic factors, perhaps to glandular conditions about which little or nothing is yet known.

Temperament. The temperament of an individual is his prevailing mood as indicated by the general character of his emotional responses. Body chemistry including endocrinological conditions is largely influential here, too, if not entirely responsible for temperamental characteristics, though one's

ways of responding are built to a considerable degree in terms of his experiences. Hence within rather confined limits of medical knowledge, glandular treatment coupled with educational training may bring about desirable modifications of temperament.

The following is the traditional list of temperaments, which has come down from classical times:

Temperament	*Meaning*
sanguine	quick-weak; enthusiastic, changeable
melancholic	slow-strong, depressed
choleric	quick-strong; easily enraged
phlegmatic	slow-weak; passive, indifferent

While almost every new physiological discovery has resulted in efforts at reclassifying the temperaments, and numerous systems have been worked out, they are not much more successful than the one given here.

Attitude. In general, emotional attitudes are of two sorts, which may be called positive and negative, favorable and unfavorable, or for and against, with a middle region of indifference. The intensity of one's dislike for other individuals has been expressed quantitatively on a scale in terms of *social distance.*[9] Thus, some people would be sent out of the country, the state, or the city; others would be allowed within these boundaries, but would be kept out of the neighborhood, club, or home. Some are accepted if they "know their place," which is often not defined geographically but only by a complicated, unwritten code of conduct.

Religious, political, and social institutions have developed various techniques to arouse favorable attitudes toward them. In these, *symbolism* plays an important part. Thus, flags, banners, badges, and uniforms stand for the institution, demand certain prescribed practices, and stimulate intense emotional attitudes. Ritual and pageantry have a similar value.

Slogans and other kinds of propaganda, as well as the milder forms, publicity and advertising, all seek to build up attitudes and direct action ranging all the way from fighting a war to buying groceries.

It is a peculiar and unfortunate fact that reason and intelligence play a very minor part in these techniques. A flag and a brass band at a political rally, or a pretty girl in an advertisement, are apparently much more valuable than a logical argument. Complicated political and social interrelationships, if reduced to a symbol or a type, can be responded to positively or negatively, with vigor. Ideas people have of other people, or of groups — Catholics or Baptists, Democrats or Communists, bankers or clerks, Negroes or Indians, Turks or Italians — tend to become rigid, fixed in the form of what has been called a *stereotype*.

New knowledge has very little influence in changing these stereotypes; and though they may symbolize only a part of the truth, or be entirely false, they carry a sense of conviction with them that completely satisfies the possessor and often convinces his hearers. While it is probably impossible to eradicate these stereotypes, it should be possible to renovate them from time to time so that one's judgments are not circumscribed by his accustomed newspaper or the nature of his childhood environment.

Attitude scales [10] have been developed which measure the extent to which an individual is favorably or unfavorably disposed toward a given racial, religious, or political group or institution. A scale is made up of a list of statements of opinion ranging from the most to the least favorable, and the individual checks those with which he finds himself in agreement.

Groups thus measured have been subjected to motion-picture films which are propagandistic in nature, and then remeasured. Average changes have varied as much as one fifth

of the total range of the scale, though after a few weeks the scores tend to move back close to where they were at the start. Continuous stimulation is apparently necessary to effect any permanent change.

Summary. Emotion both as conscious experience and as observable behavior is diffuse response. Judgments of the emotional states of others are far from accurate. Physiologically, the sympathetic segment of the autonomic nervous system innervates much of the musculature of emotional response and is supposed to prepare the body for physical emergency. Among the far-reaching effects of the endocrines or ductless glands are emotional changes. Mood, temperament, and attitude are more complex mental states involving emotional factors.

QUESTIONS

1. What kinds of barriers (thwarting situations) are for you most likely to provoke emotional responses?
2. Cite cases in which teachers have unnecessarily aroused antagonistic emotional attitudes in their pupils.
3. Give as careful an introspective account as you can of how you feel when angry, worried, or joyful; then describe someone else in the same emotional state How do the two accounts differ?
4. How do the James-Lange and emergency theories emphasize the physiological and behavioral aspects of emotion?
5. Describe any situation when you have misjudged the emotional response of someone or when you yourself have been misjudged.
6. What are some of the phrases which are sometimes used in stories to describe the responses for which the sympathetic nervous system is responsible?
7. To what glandular conditions may the following be due: obesity, idiocy, giantism, cretinism, precocious puberty, dwarfism, goiter, myxedema, excitability?
8. List and describe some stereotypes you may have encountered.
9. Could anything make you change any of your attitudes? Explain.

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CHAPTER IV

PERSONALITY ADJUSTMENTS

Escape. When an individual is motivated by a natural or an artificial system of rewards and punishments so that a conflict situation develops, as described in Chapter II, he tends to escape from the field of forces which affect him. If in his efforts to escape he comes into contact with barriers which block and thwart him, strange and irrational ways of escape may be found. They have been described by psychiatrists and psychoanalysts, but many of them turn out to be surprisingly familiar experiences.

I. EMOTIONAL ESCAPE

Mental disease. The most immediate method of escape is an emotional outburst, which seems to reduce the tension and may have a practical effect in summoning assistance and thus eliminating the punishment or the barriers. When emotional outbursts continue to be thus rewarded, they may develop into temper tantrums and become a habitual way of responding to thwarting. Hence they will be likely to continue as long as the child is rewarded for them by getting what he wants.

However, if such emotional methods are unsuccessful and the conflict situation remains unaltered, various forms of mental abnormality may develop. The most common is familiarly known as a nervous breakdown, or more technically as *neurasthenia.* The symptoms are irritability, depression, frequent weeping, fatigue, headache, and insomnia. If the condition is more severe, it is referred to as a *neurosis.*

Neuroses develop in war situations ("shell shock"), when the soldier is compelled by discipline and duty to advance and by the certainty of death and destruction to retreat. They develop in prisons where the desire for freedom comes into conflict with masonry walls and prison discipline. Neuroses likewise develop in schools and colleges, where the student feels compelled by ambition, social pressure, and the like to undertake tasks and meet standards which for him are quite impossible.

Hysteria is one recognizable form of neurosis, though it is characterized by many strange and diverse symptoms.[1] Paralysis, anesthesia or the loss of sensitivity to pain with no apparent physiological cause, amnesia or prolonged forgetfulness, and the infrequent double or alternating personality are examples. Other symptoms of mild or more severe disorder are tics or involuntary movements usually of the facial muscles or of the hands, sometimes stammering, and phobias or abnormal fears. Some of the more serious symptoms are: unfounded suspicions; delusions, in which the patient may think he is some important person, or that other people are plotting against him; and hallucinations of sight and hearing, as when the patient believes imaginary people are present and talking to him.

Two severe mental diseases, often called *psychoses*, are distinguished: *manic-depressive insanity*, characterized by slow alteration from extreme excitement and maniacal raving, to just as extreme melancholy, and back again; and dementia precox or *schizophrenia*. In the latter, which often attacks young people in their teens and twenties, the patient seems to shut himself off from others, losing interest in everything. He becomes more and more taken up with his own vivid imaginings — hallucinatory visions and voices — which may be consoling, or violent and accusatory. The slow mental

deterioration of schizophrenia in mild, undiagnosed cases some believe to be the cause of certain school failures. *Paranoia* is a disease in which the patient holds to some fixed system of ideas, while being normal enough in other respects. Paranoid symptoms are often found accompanying other mental diseases.

Causes of mental disease. Some mental diseases[2] develop from known causes, though in rather obscure ways. For example, infections of teeth and tonsils, excessive alcoholism, and the germs of syphilis, which latter, when they affect the brain tissues cause *paresis* or general paralysis, are known causes of mental symptoms. There are those who believe that all other mental diseases also have some organic cause which has not yet been discovered. Others believe that certain diseases are functional, that is, that the trouble is in the working of the mind, in the responses which a physiologically normal individual makes to the thwarting barriers of his environment. Many ingenious theories have been put forward to explain mental disorders, and many efforts at cure have been tried. But to Macbeth's question put to the physician, "Canst thou not minister to a mind diseased?" psychiatrists must yet reply only that they can help a little.

2. DESIRE AND CONFLICT

Psychoanalytical practice. The most widely known system of beliefs in regard to the cause and cure of mental diseases has been elaborated by Sigmund Freud[3] of Vienna, 1856– . His ideas have created a veritable revolution in thinking on psychological problems, and many who are not themselves psychoanalysts or psychiatrists have been influenced by them, including psychologists, vocational counselors, and even authors and playwrights.

The psychoanalyst, as a practitioner, encourages the patient to tell him everything that comes into his mind, including his dreams. Freud originally taught that patients have had some unpleasant shock or emotional experience which they "put out of their minds" or repress and forget, but which keeps on stirring them up, even though they do not remember the event that is the cause of the trouble. The analyst's interpretation of the patient's remarks and dreams was supposed to call this back to consciousness, so it could then be discussed freely and shown to be harmless enough. Thus analysis was cure, though it might take many meetings lasting over a period of several months.

Psychoanalytical theory. The technique of psychoanalysis has not changed greatly, though the theory has undergone many modifications. The concept of the *libido*, a dynamic, striving unconscious, is basic, however. This striving, if in the direction of socially disapproved conduct, gives rise to a *conflict* which, the Freudians believe, becomes repressed, but still remains active in the unconscious and thus gives rise to the symptoms of mental disease.

A *complex* is a cluster of such conflicting ideas all emotionally toned and ready to set off action in different directions. The original shock or trauma, as a cause of psychopathic symptoms, was later supplemented by certain natural childhood conditions apt to produce conflicts.

The *birth trauma* symbolizes the child's first loss of security and his first conflict with the world. The *Oedipus*[4] *complex* is the name for his infantile affection for the parent of the opposite sex, and his conflict and rivalry with the other parent. This stage is followed by the *Narcissistic* level of self-exploration or self-love, then by the *homosexual* stage of interest in others of the same sex — "crushes," the gang age, etc. — and lastly by the *heterosexual* stage of fixation upon a member

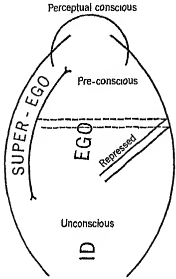

FIG. 7. THE ANATOMY OF THE MENTAL PERSONALITY[5]

of the opposite sex. In the transition from one level to another, all manner of conflicts are possible, which tends to bear out the contention that no one is quite normal. And the child, though growing to adult years, may become "stuck" or *fixated* at some childhood level, with the result that a whole series of conflicts may develop. The solution for the adult, then, is the fixation of the individual upon some acceptable love object or person. Marriage may provide the proper avenue, as may some cause to which the individual may devote his life. The latter is called *sublimation.*

Freud views the mind as partly conscious but more largely unconscious. The *ego* is both, and maintains contact with the world of reality through the senses. The *super ego* is the controlling factor which, like conscience, a sense of right and

wrong, and a knowledge of proper social behavior, directs and controls conduct. The *id* is entirely unconscious, perhaps close to the organic processes, without any sense of time or place, merely seething desire (Fig. 7).

Freud's emphasis upon health and sex, his somewhat extensive claims, and a technique which receives those sympathetically whom doctors turn away, have all contributed to his popularity On the other hand, these very things, together with his elaborate theories, often put forth without a shred of scientific evidence to support them, have made many suspicious of the whole thing.

At least it may be said that he has focused general attention on important problems of personality which had been neglected. And while the psychoanalytic technique is out of place in the schools, the point of view has done much to stimulate a sympathetic interest in children's problems of adjustment.

3. IMAGINATIVE ESCAPE

Phantasy. When some persons are frustrated in the satisfaction of their needs, they seem to find satisfaction in phantasy or daydreams. These provide an imaginative realization of their desires. Individuals escape from the level or plane where their conflict lies to an imaginative one which they build in such a way that punishments are avoided, barriers are surmounted, and their goals are attained.

The game of "just pretend" becomes a temporary substitute for intelligently directed effort. Thus many boys daydream that they are great athletes and girls that they are great singers, young men that they are promoted rapidly and young women that they are most attractive to young men. The Aladdin story and the Cinderella theme with many varia-

tions are played again and again, and always find a hearing because they give form to these imaginings.

The basic need most certainly satisfied by the greatest number of daydreams is that of prestige, or social recognition. This is not always gained by the child's imagining he is someone very important, but often by his imagining that he is in great distress or danger, perhaps that he is dead, and *that* makes people sorry they haven't been as nice to him as he thinks they should be. Thus the effect is the same in either case.

When daydreams pass over the line so that they are no longer recognized as imaginary and instead become delusions which are mistaken for reality, the same two kinds appear. There are the *delusions of grandeur* in which the person thinks he is Napoleon, or the possessor of immense wealth, or even God, or the Virgin Mary. And there are also the *delusions of persecution,* in which the patient believes he is being followed or attacked — he is always important enough to have powerful foes.

Talented individuals often portray their daydreams artistically in symbolic form. But the efforts of the musician, the artist, and the poet involve overt activity guided and perhaps motivated by the desire to make dreams come true. Religious people of all nations have imagined heavens of various sorts which are expected to make up for the frustrations found in actual life. Socially minded writers have from time to time described Utopias, lands of nowhere, of a sort more nearly to their heart's desire.

Daydreaming is, of course, very common, and as an imaginative realization of any need or desire, is harmless enough in small doses. If, however, a child finds his only satisfaction in his fantasies, and avoids contact with other children, it will be well to arrange that such contacts be made pleasant and agreeable and so to encourage them. No one has proved

that such encouragement keeps dementia precox from developing, but the disease usually shows a case history of excessive daydreaming.

Identification. The readers of success stories of love and adventure, as well as the people in theater and motion-picture audiences, tend to identify themselves with one or another of the characters portrayed, and so escape imaginatively for the time from their own misfortunes or humdrum experiences. They *are* the hero or heroine, handsome and heroic, or beautiful and charming, whether the parts are portrayed delicately, or in the bold relief against the machinations of the villain in the old-fashioned type of melodrama.

One reason why some of the modern fiction and dramatic literature does not appeal to certain people is that none of the characters is sufficiently admirable; there is no one for them to identify themselves with. On the other hand, some stories, especially as portrayed on the screen, cause juveniles to go beyond imaginative satisfactions and make special efforts to be like the heroes and heroines in word and action. A number of juvenile delinquencies, for example, have been traced directly to such emulation.

4. IRRATIONAL ESCAPE

Rationalization. It is common practice for people to explain away a weakness or a mistake in ways which will make them seem more acceptable to themselves and to others. This practice is called rationalization.[6] It provides an escape from reality which involves not so much the emotions and imagination as the thought processes themselves.

Rationalization takes many forms, some of which recur so frequently that they are given special names. The ancients[7] knew this weakness of man, and pictured it for all

time in the fable of the Fox and the Grapes. The fox was thwarted in his desire for the grapes, so he explained away his failure by saying that the grapes were sour, that is, by belittling what he could not get. When one hears a similar belittling of wealth, scholastic standing, political preferment, beauty, talent, or even of generosity and kindliness, one suspects that there is failure or ineffectual endeavor back of it.

Some go one step further and, instead of saying that the grapes are sour, say that they are no doubt sweet, but one is better off without them. There is another fable of a fox who lost his tail in a trap and tried rather unavailingly to make his comrades believe that he looked better without it. Pollyanna is a fictional character who has a gift for pretending that her misfortunes are good for her, that a sour lemon is really sweet, that failure is best. Of course, it is often true that people are better off for not having what they want, but this is not necessarily true of the bungler, the inefficient, and the unsuccessful.

Projection What is perhaps a still more common form of rationalization consists of projecting the cause of one's mistakes and failures upon others. The sentiment of the old ballad, "You made me what I am today," is echoed a thousand times over at home and at the office, at school, and on the playground. "It is a poor workman who quarrels with his tools" is an old saw which expresses contempt for placing the blame in the wrong quarter. Disappointed office-seekers blame their luck, politics, and pull; poor students blame the teacher, the examination questions, the weather, or perhaps their heredity or environment — which may be nearer the truth. Poor golfers blame the wind, and backsliders the devil. They all may be right, but one suspects that in some cases they overlook one good and sufficient reason for their failure, namely, themselves, their lack of knowledge or skill, or of intelligence or perseverance.

Retreat from reality. Such efforts to escape reality are vir- ılly a retreat, but the retreat becomes a rout when the indi- lual deliberately closes his mind to the facts and figuratively ries his head in the sand, as the ostrich was once believed do at the approach of a foe. The countryman at the fair ıo looked at the giraffe and swore there was no such animal a blood brother of the man who says, "I never have acci- nts," or that no one needs to be unemployed because he ı't, or the one who declines to look into the nature of the lamity, be it financial, social, or military, which may over- ıelm him. Some go into danger with their eyes open; others ɜ of a blind and trusting nature — and they never know ıat hit them.

5. RETREAT AND COMPENSATION

Physical retreat. In a broad sense all the ways of escaping ficulty discussed thus far are compensations in that the lividual makes up for his weakness or failure in one way or other. But the retreat is more commonly thought of as me form of action. It may be a physical escape — running ay from the situation, escaping from the field, and estab- hing oneself in a simpler environment where one's needs n be more easily attained. Such a retreat may be wise, or may be cowardly or even psychopathic.

Circumstances determine the advisability of taking easier ther than more difficult courses in school or college, of taking one's bed and thus avoiding hard work, of living the life of recluse or a hermit. Suicide is complete retreat, while the urotic rebellion against impossible situations at school, at me, or in the office, in the form of stammering, tics, and sterical paralysis, has already been discussed.

The inferiority complex. The concept of compensatory

behavior has been popularized by Alfred Adler, of Vienna, whose psychoanalytical doctrines[8] and techniques owe much to Freud but are better adapted than his to educational uses. Adler, as has been mentioned, holds that everyone strives for power; but in seeking the power goal, the individual discovers his own inferiority. At first, organic inferiority was stressed — sterility or impotence, crippled limbs, and other forms of physical handicap To these have been added the social handicaps of the poorly dressed, and of petted children, the former because they are looked down upon by others, the latter because at school they miss the attention and prestige they are used to at home, and seek various ways to obtain it. All these individuals develop a feeling of inferiority, or, in more extreme cases, an inferiority complex.

They may make heroic efforts to compensate for this inferiority. Beethoven composing symphonies after he was deaf, Emperor Wilhelm, with his withered arm, seeking to dominate Europe, and Theodore Roosevelt, a weakling in his youth, swinging the "big stick" are mentioned as outstanding examples of compensation for inferiority.

Foolish and wise compensations. The danger of the inferiority complex, Adler points out, lies in the fact that often foolish and anti-social means of compensation are sought. Thus boasting, lying, stealing, cheating, bullying snobbishness, and other forms of undesirable behavior and even delinquency are viewed as efforts to compensate for physical or social inferiority.

Even allowing for psychoanalytical exaggeration there is no doubt a great deal of truth in this contention, so much so that schools seek to provide, through clubs and other activities, various ways in which different children may compensate for their inferiority by gaining prestige in social rather than in anti-social ways.

Cooperation. As a step beyond the encouragement of individual success, which many cannot attain in any sphere of activity, pupils are also encouraged to find satisfaction in the achievements of their group. Though the contribution of one to the group may seem slight, it is yet a part, and the success of the group redounds to the glory of each one in it.

Opportunities for cooperation are afforded not only by athletic games, but also by class or school projects. These furnish the occasion for special talents to develop, and for future leaders to learn the ways of leadership. Exploratory efforts in many schools have adapted a cooperative, problem-solving technique to instruction, and even to problems of school management and discipline which were formerly handled autocratically by the teacher or principal. Of course, there are weaknesses in such schemes, due to the immaturity of the pupils, but the experience they gain is viewed as a part of their education in democratic practices.

6. INTELLIGENT ADJUSTMENT

The world of reality. Just why some individuals choose one way of adjusting to their difficulties and others choose other ways is not known. It is probably due to a combination of the structure of the nervous and glandular systems and the success or failure of the chance responses they made early in life. Be that as it may, what an individual does when he is thwarted remains a reasonably good key to the understanding of his personality.

If his responses to thwarting are emotional explosions, if they are fanciful imaginings and vain delusions, irrational excuses, or anti-social compensations, he is tending to live in an unreal world. He may need help to regain the world of reality, the cause-and-effect world disclosed by generations

of thinkers and scientists, the natural and social environment of those who are of sane mind.

"Will-power" vs. substitution. It may be urged that the intelligent thing to do when confronted by a difficult situation is to redouble one's efforts, to use one's "will power," as the phrase is, to strive more vigorously and persistently than ever. In many cases this is no doubt true, and often a little encouragement will persuade the individual to try again. Difficult number combinations or problems, evasive foreign-language idioms or passages, and disagreeable tasks or exacting responsibilities often yield to renewed attack.

A caution should be urged, however It sometimes happens[9] that one's ambition exceeds his abilities. His *level of aspiration* is so far above the level of his ability that he is doomed to failure from the start. In such cases, good judgment or kindly counseling should point out the advisability of lowering the level of aspiration and substituting some worthwhile activity within the range of one's abilities.

Facing reality. There is no real necessity for rationalizing a change of plan; it is much better to recognize frankly a mistake in judgment and seek to rectify it. No one is peculiar in not being able to do all that he could wish. Nor is it unusual to find oneself confronted with unexpected difficulties or misfortunes which demand new adjustments. It is the part of wisdom to learn the nature of the world and of oneself in relation to it, and meet the situation as intelligently and as adequately as one can.

Intelligent adaptation. Fortunately we do not need to meet every misfortune or difficulty with passive acceptance and philosophic calm. Science has given man a control over nature such as he has never had before. Many more human desires and needs can be better satisfied than was formerly

possible, and scientific instruments are available by means of which new problems can be solved.

The solution of many individual problems is simple, that of others is much more difficult. The treatment of those suffering from mental disturbances, both mild and serious, is much more wise than it was years ago when they were treated more as dangerous criminals than as patients. This change has come about in no small measure through the efforts of Clifford Beers[10] and the activities of the mental hygiene movement which he founded. In dealing with individual problems the technical or professional advice of a mental hygienist or a psychiatrist may be needed; or education, experience, and ingenuity may show the way. Perhaps a few illustrations will make the point clearer.

The fox might have hunted for a ladder to get the grapes and so been as wise, and certainly quite as ethical, as the fox in the other fable who used flattery to get the cheese from the crow. The student who has difficulty with his work might check up on his study habits or take a different program of studies. The girl who isn't popular might discover what to say that would not hurt people's feelings or hold them up to ridicule, or ask someone how she can improve her style of dress. The teacher who is having difficulty in keeping order might discuss the matter with the supervisor and work conscientiously on his suggestions.

Of course, the ways to meet the difficulties given here are not the only ones. But people who learn to avoid the infantile, irrational, and stupid ways, view each difficulty as a problem, and intelligently seek the adequate solution.

7. PERSONALITY TYPES

Personality. There are many confused meanings of personality which are often used vaguely in common speech. Perhaps the most satisfactory definition is the total characteristic response pattern of the individual as it affects others. This would include temperamental and emotional factors.

The criteria by which personality is judged differ, and hence there is little agreement on what constitutes a good or a poor personality. What is good for a salesman might be poor for a research worker. A person is his own judge of another's personality, on the basis of what appeals to him, even though it does not appeal to someone else.

Many efforts have been made to classify people more or less objectively into personality types. None of these is particularly successful, for the reason that there is so much overlapping; people do not fit nicely into separate categories. But the attempts are perhaps helpful in understanding people and their reactions.

Introverts and extroverts. The best-known type classification is that of C. G. Jung, a Zurich psychoanalyst who differs from Freud in many of his views. Jung's classification[11] has been simplified by American psychologists who have attempted to make it a *dichotomy*, that is, a two-fold classification. The need for a name for those who fall between the two extremes of introversion and extroversion has been met by the coining of the term *ambivert.*

The introvert, as the name implies, is turned inward in his emotions and his thinking. He judges in terms of what he himself believes, in spite of what others may think. The extrovert, on the other hand, is turned outward toward the world, and judges in terms of what others think. The intro-

vert and extrovert are supposed to have such characteristics as the following:

Introvert	*Extrovert*
Likes to be by himself a great deal.	Enjoys being with people
Thinks things out, has convictions	Is swayed by suggestions of others.
Keeps in background on social occasions.	Prefers lively crowd of people.
Indulges in revery	Does not daydream much.
Prefers to read about things.	Prefers to do things.

Tests[12] of introversion-extroversion have been devised that are made up of questions on such items as the above, which the individual taking the tests answers about himself. The results, however, are little more than approximations, which is understandable since such a scale oversimplifies the concept. In addition Jung listed four other types, the *sensation* type, the *thinking* type, the *feeling* type, and the *intuitive* type. Each individual has one of these as his dominant type, in which he is introverted if he is an introvert, and extroverted if he is an extrovert. But he is unconsciously motivated in the direction of the other type in respect to the other three classifications.

Pyknics and leptosomes. Another dichotomy, well known at the present time, is that formulated by Ernest Kretschmer. His classification[13] differs from the others in that physical and psychological characteristics are paired. Thus his pyknic type is that of the jolly fat man, the "hail fellow well met," sociable, good-natured, perhaps sentimental and soft-hearted. His leptosome or *asthenic* type is represented by the lean, sour-faced individual, unsociable, reserved, perhaps eccentric, shy and sensitive. Between the two is the *athletic* type, while the *dysplastic* group is made up of various irregular types which cannot be readily classified with the other groups. Women are not included in Kretschmer's scheme.

What focused attention on this classification was its appli-

cation to mental disease. Kretschmer concluded that practically all manic-depressives were of the pyknic type and that nearly all schizophrenic patients were leptosomes. This provided the opportunity to study the personality characteristics of each disease as they appear in their milder forms in normal persons.

Spranger's types of men. A third contemporary type classification is that of Eduard Spranger of Berlin. Spranger's classification[14] is in terms of life values, the kind of things different people consider important and most worth while. He designates six so-called ideal types; for he does not pretend that any one person exemplifies a pure type. He has worked the system out in great detail and shown the effect of different combinations of different types, and the way persons primarily of one type regard those of another.

In brief, the ideal types delineated are the following:

> *Cognitive* or *knowing* — the philosopher or scientist, whose interest is in the truth.
>
> *Esthetic* or *artistic* — the artist, whose interest is in beauty.
>
> *Economic* — the business man or industrialist, whose interest is in minimizing effort and cost.
>
> *Religious* — the priest or mystic, whose interest is in his relation to the seen and unseen world.
>
> *Political* — the statesman or politician, whose interest is in wielding power.
>
> *Social* — the social worker, reformer, or meliorist, whose interest is in the welfare of his fellow men.

It may be that the individual who uses such a classification will come to recognize in others values which he himself does not esteem so highly, but which should be encouraged and directed.

The integrated personality. The goal of education, so far as personality development is concerned, is social adjustment and individual integration. If attractiveness and charm can be added, so much the better.

Integration means a harmonious balance between one's desires and one's capacities, and is the condition of mental health. Mental disintegration is insanity, in which the individual is torn between conflicting demands of reality and a hallucinatory, unreal world. Incomplete integration is to be found in those whose conflicting desires for unattainable or mutually exclusive goals render them unhappy or ineffective.

Adjustment includes integration but emphasizes the relationship between individuals. If a person is maladjusted socially, he is unable to get on with other people or groups, perhaps because of overemotionality, selfishness, a domineering attitude, or a lack of social experience, so that he doesn't know what to say or do in various social situations.

Adjustment does not imply submissiveness or subservience. If the individual is qualified to lead in a small or a large way, that is the form which his adjustment to circumstances should take. Mastery of a situation may be the best form of adjustment. Those who are individually integrated and socially adjusted are capable of a harmonious relationship with their environment either by assuming leadership or dominance, or by yielding to others or to circumstances as the occasion may require.

Many of the present-day efforts of the schools, which seem to many to be far removed from books and the "three R's" of the old days, aim to provide opportunities for the development of integrated personalities, capable of adjusting to the demands of social living. Projects, activities, clubs, shop work, the cooperative solution of social problems, and also

the counseling service and the health and behavior clinics have this as their objective.

Such activities which have as their aim the better integration and adjustment of pupils constitute what has been called a "eupedic" program The term, meaning better children, is more definite than the vague phrase "character education" and serves to emphasize the importance of pupil integration and adjustment in the school program

Summary. There are many consequences of thwarting which serve in more or less satisfactory ways to provide for the individual's escape from the field of conflict: emotional escape by infantile outburst or neurotic symptoms, imaginative escape by phantasy and identification, irrational escape by rationalization and projection, and compensatory escapes.

Such evasions and deceptions are usually unnecessary and quite unsatisfactory ways of meeting difficulties. Instead, intelligently directed compensation (or "sublimation") and determination, the willingness to face reality and adjust wisely to situations as they arise, are more satisfactory ways.

Classifications of people according to personality types are based on their characteristic ways of responding to various kinds of situations. Schools which aim to meet the needs of different types of pupils provide opportunities for social experiences which will contribute to their all-around development.

QUESTIONS

1. What are the differences between "getting hysterical" and the actual symptoms of hysteria? Do you see any similarities in the causation?
2. Do you know anyone who has had a "nervous breakdown" (neurasthenia)? What were the symptoms? The treatment? How might it have been avoided?

3. Compare the techniques of psychoanalysis with those of any mental or faith cures which you may know about.
4. If you know of any, describe some cases of fixation which outlasted the age for which they might have been normal.
5. Make a collection of favorite daydreams from among your friends. What likenesses do you find? From what unpleasant realities (barriers) are they endeavoring to escape in each case?
6. What evidence of identification do you find in children? in adults?
7. Make a collection of rationalizations; of projections. Indicate any which you think were justified by the circumstances.
8. List some anti-social compensations for inferiority; some useful ones.
9. Do you know of any cases where the level of aspiration was too high? What was the outcome?
10. If possible, procure an introversion-extroversion test and after taking it analyze the result in connection with the answer key.
11. What do you think each one of Spranger's types of men would think of each of the others? What would individuals be like who combined any two of the types?
12. Describe some school devices with which you are familiar which tend to promote better individual integration and social adjustment. In what respects were they satisfactory, and in what respects might they have been improved?
13. What can you as an individual do to ensure your development as an integrated personality?
14. What could you as a teacher do to help pupils toward better individual integration and social adjustment?

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   The Freudian use of names from classical mythology supposedly shows the fundamental characteristic of the phenomena in question. Thus Narcissus, according to the story, fell in love with his own image reflected in a pool

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6. J. H. Robinson, *The Mind in the Making, New York, Harpers, 1921, pp. 40–48, Bernard Hart, *+The Psychology of Insanity*, Cambridge, University Press, 1916.

   Robinson refers (p. 47) to Pareto, and identifies rationalizations with Pareto's "derivations." The term has been widely used by psychoanalysts and mental hygienists and has found its way into popular speech.

7. Other fables than that of The Fox and the Grapes may be used to illustrate various escape mechanisms, for example:

   Rationalization: The Wolf and the Lion; The Fox without a Tail.

   Projection: The Spendthrift and the Swallow; Fortune and the Boy.

   Phantasy: The Covetous Man.

   Compensation: The Brother and Sister; The Peacocks and the Jay; The Frog and the Bull.

   Determination: The Harper; The Hare and the Tortoise.

   Intelligent adjustment (without respect to ethical values!): The Hares and the Frogs; The Lion and the Elephant; The Lion and the Asses and the Hares; The Crow and the Pitcher; The Crow and the Mussel; The Lion and the Four Bulls; The Fox and the Raven.

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CHAPTER V

INTELLIGENCE

Intelligence and thwarting. People differ widely in their ability to meet successfully the various life problems which confront them. Some are even unable to take care of themselves in a very simple environment, while others find delight in exploring the unknown for challenging problems to solve. The former have been exposed or put to death, ridiculed, or cared for since history began; the latter have managed the world's affairs, or made the discoveries which have gradually changed the character of man's life from the early hunting and pastoral cultures to the present highly mechanized stage of civilization.

I. LEVELS OF INTELLIGENCE

The feebleminded. Wide differences in native ability are found, of course, not only among adults but in children as well. It is the purpose of this chapter to inquire into these differences, how they are measured, and what the schools are doing to adapt their program to the needs of pupils at different levels of intelligence.

Those who are below normal in intelligence are called feebleminded, though the term is usually applied to the upper levels of mental deficiency. The lowest level is *idiocy*. The true idiot is unable to take care of himself any more than a one- or two-year-old child. There are microcephalic idiots with unusually small heads, and macro- or hydrocephalic idiots with unusually large heads. But apart from a few such extreme cases, differences in intelligence are distinguished not by head

size but by behavior. *Imbecility* is the next higher stage of feeblemindedness. Imbeciles have about the intelligence of two- to seven-year-old children, and they must be taken care of either in an institution or at home in an extremely simple environment.

The name *moron* has been given to the subnormal of the high-grade feebleminded level, many of whom are doing unskilled labor or are more or less permanently unemployed. The high-grade morons can look after themselves fairly well in an institution or other simple environment, and are often good at caring for children when judgment is not needed. They can be trained to do simple work like farm labor, cobbling, simpler shop work, scrubbing, washing dishes, and waiting on table, though they usually go on with the routine they have been told to follow even if altered circumstances call for something different. The better training schools for the feebleminded do excellent work in giving children such training as will enable them to take care of themselves and so not become a public charge.

One naturally wonders why some people should be thus handicapped. In the main there are two *causes of feeblemindedness* — heredity and disease. The children of feebleminded parents are more likely than not to be feebleminded, and every institution has its families, brothers and sisters, and their children, all cared for at public expense. Some states have laws permitting sterilization. As people realize that this operation does not maim, but only gives release from the burden of the unlimited reproduction of feebleminded children who cannot be cared for, the early opposition to its practice in institutions is gradually waning

Certain diseased conditions produce feeblemindedness, meningitis, for example, with its accompanying loss of motor coordination. A deficiency in the thyroid gland results in

cretinism. The discovery of the cause of this clinical form of feeblemindedness and its cure by continued dosage with thyroid extract was one of the triumphs of modern medicine. The cause of another clinical form, *mongolianism,* so called because the victims' features are supposed to resemble the Mongolian somewhat, is unknown, and it has not yielded to scientific attack.

Differing abilities among the normal. A rather wide range of ability is to be found among those who cannot be classed as feebleminded on the one hand, and who show no signs of mental superiority on the other. The so-called *dull normal* constitute the greatest problem in school, sometimes because they have been advanced more rapidly than they should have been from one grade to the next, until they find themselves expected to do work which they are incapable of doing. Or they may be difficult to handle properly because the school is not equipped to provide them with the kind of education best suited to their needs. The best school practice at present keeps the dull normal in their own age groups, but gives them tasks suited to their abilities. They adjust better socially when grouped with children of their own age.

Those who are of normal intelligence, of course, have numerous special *abilities* as well as special disabilities. Though their average school performance maintains a fairly constant level, the performance of individuals, and of the same individual in different subjects, varies considerably. However, a great number of useful occupations requiring all sorts of different skills are carried on by those of average intelligence. In fact it would seem that schools and other human institutions as well are designed especially for them.

The superior. Those above the average in intelligence are the ones for whom education has been provided in the past, the others having been apprenticed to artisans or tradesmen,

conscripted for armies, or bound to the earth as unlettered peasants or slaves to till the soil. For centuries the colleges and universities have opened to those of superior intellect the stores of accumulated knowledge and trained them for the learned professions — medicine, law, theology, and later, science.

True, the selection was based in large measure on birth and hereditary wealth, and there were undoubtedly many noble dullards and many wise commoners, yet by and large the successful were people of ability, and their children profited. But with this long history of education for those of higher intelligence, it can even now be said that there is no agreement about how, as children, they should be educated.

The ancient Greeks, whose culture reached a higher level than any before or since, provided a curriculum made up chiefly of sport, literature, and music. The men of the Renaissance read the products of Greek genius, and the scholastics studied them in Latin translation as well as the Latin writings of the Romans and of their own great. Schoolboys studied the necessary languages, and were forced to continue this study after the classics could be read in the vernacular. Meanwhile mathematics and physics came into prominence, and later the biological sciences. So now, with all the past to choose from, the superior are provided with a multitude of intellectual riches and little basis for choice save their own predilections.

As in the past, vocational interest is a decisive factor, and the schools provide the preparation needed for the higher branches of learning. Following European models, the so-called preparatory schools developed in this country, with curricula so planned as to guarantee their graduates entrance to the university. In the European countries those who thus prepared themselves attended separate schools; whereas in

the United States the high school cares not only for these but also for the majority who will carry their formal education no further.

This has resulted in certain unfortunate consequences. The average have often been compelled to go through the motions of preparing for college which they will never attend, and the superior have been held back by academic and social pressure to the performance of the less gifted. There seems to be no satisfactory way out of this dilemma except as schools learn to take pride in fitting pupils to live well the life they are to live, whether the academic level be high or low.

Because of a few dramatic cases, it has been supposed by some that superior children are apt to be queer, that their mental advantage is in reality a handicap. But this has been shown to be fallacious. Lewis M. Terman (1877–), of Stanford University, has made a very detailed follow-up study [1] of highly superior children and has found that they are quite as free from neurotic symptoms, as healthy, and as well socialized as other children. In fact on most counts the gifted group intellectually were even better off than the others. When with the passage of the years the "superior child" finds himself competing with others of his mental caliber in the colleges, and in the professions, any feeling of individual peculiarity he may have had gradually disappears.

2. WHAT IS INTELLIGENCE?

Kinds of intelligence. Various types of intelligence have been differentiated and described, though they may be but different aspects of some basic psycho-biological condition. Abilities giving evidence of different directions of development of intelligence may be classified as abstract, concrete, and social. Natural ability in manipulating abstractions or

symbols — that is, words and numbers — is most in demand in the schools. It is the kind that has been discussed thus far, and is usually called *general intelligence* or mental ability. Abilities in handling concrete or *mechanical* objects are called for in working skillfully with materials in shop or laboratory. *Social* abilities are needed to get on with people, to perceive their motives, to lead, or to attract others. How far these abilities are native and how far they are the result of training it is difficult to say. Excellence may be attained along any one of these lines, but an all-around development as well as true superiority demands the exercise of all three.

Criteria of intelligence. There are two chief ways by which one can recognize low intelligence. One of these is the *economic* criterion. The British Royal Commission on the Feeble-minded[2] in 1904 formulated the following definition: "A feeble-minded person is one who is capable of earning a living under favorable circumstances, but is incapable, from mental defect existing from birth, or from an early age, (*a*) of competing on equal terms with his normal fellows, or (*b*) of managing himself and his affairs with ordinary prudence." This criterion is not a very satisfactory one, since some people's affairs are much more complex than others. Rural life in the old days was not very exacting intellectually, providing one had grown up on the farm; and unskilled labor, even in unfavorable circumstances, can be done satisfactorily enough by those in the upper brackets of feeblemindedness.

The *academic criterion*, however, is the one with which educators are most concerned. Those children who are unable to progress as rapidly as the majority in school are apt to be low in intelligence, while those who lead the class are superior. The majority sets the standard. True as this is in general, rate of progress in school may be dependent on a number of other factors such as preparation, motivation, interest, and

physical handicaps. In spite of the lack of standards for promotion, it has been found that the best quick way of selecting the brightest child in a grade is to pick the youngest, that is, the one who has progressed most rapidly. The older children, who have taken longer to get to the same grade in school, are in the main less bright.

Intelligence as learning ability. Since learning is the chief activity of pupils leading to promotion, one would suppose that intelligence is about the same thing as the ability to learn. Indeed this is a common and very useful definition, being reflected not only in the ease with which children move from grade to grade, but also in the facility with which they master their daily lessons. "Slow" and "fast" are words often applied to dull and bright pupils, and every teacher knows how exceedingly slow some pupils are at learning things which others get at once.

Learning is, of course, an exceedingly complex process, and all too little is known about it However, we can perhaps analyze some of the ways in which the learning of dull pupils — say twelve-year-olds — differs from the learning of brighter ones of the same age in the same environment. They are unable to *memorize* as rapidly or remember as long. They are less capable of *observing* significant things or ideas They cannot *make inferences* so readily, or *foresee consequences* and be guided by them; in other words, they are less capable of profiting from experience.

These statements do not mean that dull pupils cannot remember, observe, and infer, for they can, often with surprising acuity. But they do so in connection with school tasks less effectively than most of the pupils of approximately their own age, with whom they are usually classed.

Intelligence as mental growth. Some children grow faster and taller than others, and in any one child the organs, glands,

and muscles mature at different rates. We should therefore expect that the cortical development of different children would vary, and that it would bear no very definite relationship to their rate of physical growth. And such proves to be the case.

From the point of view of human growth, therefore, feeblemindedness is slow mental development, and mental superiority is more rapid mental development. Thus the learning of a backward child is not different in kind from that of a normal or superior child. All the processes are slowed down so that when he is twelve years old, he has just about got to the point where normal children are when they are ten, and where superior children are when they are eight years old.

Thus children of low intelligence are retarded, as compared with normal and superior children; they learn even at their own mental level more slowly. If this is appreciated by the teacher, it will be recognized that many backward children in school are being forced to do tasks beyond their capacity, in competition with those whose mental growth is more rapid; hence arises the problem of adapting instruction to their level of accomplishment.

Intelligence as the capacity to adjust. Intelligence has been defined in various ways and from different points of view. The following definitions are examples.[3]

> Intelligence is judgment or common sense, initiative, the ability to adapt oneself.... To judge well, understand well, reason well.... — Binet.
>
> An individual is intelligent in proportion as he is able to carry on abstract thinking. — Terman.
>
> Intelligence is a general mental adaptability to new problems and conditions of life. — Stern.
>
> Intelligence means precisely the power of so recombining

our behavior patterns as to act better in novel situations. — Wells.

We may then define intellect in general as the power of good responses from the point of view of truth or fact. — Thorndike.

It thus becomes evident that intelligence is about the same thing as the ability to solve problems. Biologically viewed, problems of adjustment to environment are the ones upon the right solution of which our existence depends. Though the problems are of many kinds, the significant elements in intelligence, viewed as the capacity to adjust, may be abstracted for the sake of a clearer view.

This has been done by Charles Spearman[4] (1863–), and his colleagues at the University College, London. He found what he calls a *general factor* (abbreviated *g*), which is constant for any one individual. This is to be distinguished from *specific factors* (*s*), which vary in any one individual, as, for example, musical talent or linguistic ability, and so on. The *two-factor theory*, as it is called, based as it is on somewhat complicated statistics, opens the way for an exact mathematical determination of the nature of general intelligence. Spearman enunciates two major laws.

The first of these laws, *the eduction of relations*, is stated as follows: "The mentally presenting of any two or more characters tends to evoke immediately a knowing relation between them." Such familiar relationships as similarity and difference, time, space, and cause and effect are illustrations. If the two characters "black" and "white" are presented mentally, one can immediately evoke (or educe) the knowing relation: "opposite."

The second law, the *eduction of correlates*, follows from the first: "The presenting of any character together with any relation tends to evoke immediately a knowing of the correlative

character." In this case, one particular thing and the relationship are given, to find the other; for instance, "black" and "opposite" (what is the opposite of black?) would give the other correlate, "white."

If, then, adequate samples of such thinking can be selected which are representative of what an individual does when he adapts to his environment, or when he learns, one may conclude that he will think in the same fashion in the actual situations which he meets in his daily life. And this is just what the intelligence test seeks to do.

3. MEASURING INTELLIGENCE

Pseudo-scientific approaches. Progress in science follows progress in exact measurement. This is true not only in the physical sciences but in the biological sciences as well. But the longing for exactitude has led inquirers into strange and devious paths, and only in recent years has the somewhat elusive problem of intelligence yielded perceptibly to scientific attack.

Men have long sought ways of foretelling the future successes and failures of an individual. The ancient Greeks consulted *oracles*, where devotees supposedly in tune with some god or goddess foretold the future, but often with such a weather eye open to their own welfare that their sayings could be interpreted in different ways, so that whatever happened they couldn't be wrong. The word "oracular" even now means "authoritative" and "ambiguous." The ancient Romans had their colleges of *augurers*, who professed to read the future by the behavior of sacred birds or the condition of the viscera of slain animals.

In medieval times *astrologers*, going on the assumption that the stars were connected with the lives of the people about

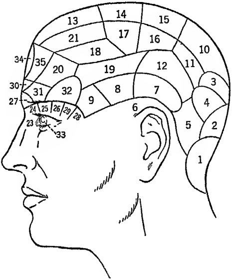

FIG. 8. PHRENOLOGY CHART [5]

The location of organs or faculties is indicated by numbers as follows·
Order I, Affective Faculties. Genus I, Propensities· 1, Amativeness, 2, Philoprogenitiveness; 3, Inhabitiveness; 4, Adhesiveness or attachment, 5, Combativeness; 6, Destructiveness, 7, Constructiveness, 8, Acquisitiveness; 9, Secretiveness Genus II, Sentiments. 10, Self-esteem, 11, Love of approbation; 12, Cautiousness, 13, Benevolence, 14, Veneration; 15, Firmness, 16, Conscientiousness or justice, 17, Hope, 18, Marvelousness, 19, Wit; 20, Ideality, 21, Imitation
Order II, Intellectual Faculties. 22, Individuality, 23, Form, 24, Size, 25, Weight and resistance; 26, Color Genus III, Perceptive faculties: 27, Locality, 28, Numeration; 29, Order, 30, Eventuality, 31, Time, 32, Melody or tune, 33, Language. Genus IV, Reflective faculties: 34, Comparison; 35, Causality.

them, worked out a complicated system of "casting horoscopes" to determine the nature of events to come. Later, *numerologists*, working with chance number combinations, *phrenologists*, *physiognomists*, *palmists*, and *graphologists*, employing ancient folklore sometimes mixed with modern scientific jargon, have plied their trades at the expense of the ignorant, and may even now be heard hawking their wares over

the radio. All of these are examples of pseudo-science or false knowledge.

It took man a long time to learn that *chance events in nature* were not intimately connected with his destiny; and he has not yet learned the relationships between his *physical proportions* and his future accomplishment, except that they are much slighter than was formerly supposed. He now searches for *segments of behavior* which are or may be significant in determining what he will do or will be able to do in the face of coming events.

The first mental tests. Sir Francis Galton[6] (1822–1911), who had developed the concept of general intelligence as early as 1869, constructed an imaginary scale of points ranging from the lowest idiots to the classical Athenians. James McKeen Cattell (1860–), who had worked in Wundt's psychological laboratory, and had also studied with Galton, sought to apply psychological techniques to the measurement of mental abilities. He was the first to use the term *mental test* in its present meaning and in 1894, at Columbia University, started the systematic testing of college students. He used some anthropological tests — lung capacity and strength of grip; some sensory tests — vision, hearing, and pain sense; and some more truly psychological tests including reaction time, memory, and imagery. But this work might have quickly died down had it not been stimulated from another quarter.

The work of Binet. Another line of attack[7] was followed by Alfred Binet (1857–1911), a French psychologist who was working with backward children in the Parisian schools. Binet, during the course of his professional life, explored a number of possibilities for determining mental ability, including graphology, physiognomy, and palmistry, but found them wanting In 1898, working with his colleague, Simon, he suggested a *number of tasks* which he thought might measure in-

dividuals in comparison with others in respect to the general ability of the mind. In 1905, they published the *first scale* for the measurement of intelligence, which included a number of the tests he had previously worked out, arranged in order of difficulty. This scale he himself used in the French schools for the purpose of selecting backward children for special classes. It was translated into English and adapted to American use by H. H. Goddard, then at the Vineland, New Jersey, Training School for Feeble Minded Children.

In 1908, as a result of his experience with the scale, Binet published a revision, with the tasks arranged according to the age at which normal children could be expected to do them. Thus, the very important and now very familiar concept of *mental age* came into being and was given an exact and practical meaning. A final revision of the test which appeared in 1911, the year of his death, was made on the basis of the use of the earlier scale, in which the position of some of the tests was altered, some being eliminated and a few new ones added.

The I.Q. and prediction. The Binet-Simon intelligence test met with wide acceptance. It was translated and adapted to German use by Wilhelm Stern, who added to Binet's concept of mental age that of the mental quotient, called by Terman *intelligence quotient* or *I.Q.* This is the ratio of the mental age to the actual or chronological age. Thus, if the M A. (mental age) is 8 and the C.A. (chronological age) is 8, M.A. divided by C.A. is 1 00, or 100 as the I.Q. is written, without the decimal point. If M.A. = 8 and C.A. = 10, the child's mentality is below the average, the I.Q. being 80. If M.A. = 8 and C.A. = 6, the child is of superior mentality, the I.Q being 133. For anyone 16 years of age or older the chronological age of 16 is used to compute the intelligence quotient. The I.Q. is thus a measure or index of brightness and provides a more exact means than any previously used of indicating

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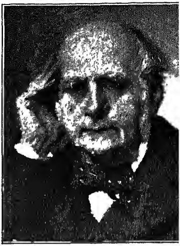
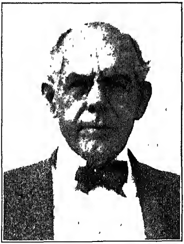
ALFRED BINET (1857–1911)
Paris



Keystone View Co
SIR FRANCIS GALTON (1822–1911)
Cambridge



Science Service
JAMES McKEEN CATTELL (1860–)
Columbia

Science Service
LEWIS M. TERMAN (1877–)
Stanford

LEADERS IN THE TESTING MOVEMENT

the level of a person's intelligence. Table 1 represents the usual categories, though there is no dividing line between them.

TABLE 1. CONVENTIONAL NOMENCLATURE OF DIFFERENT INTELLIGENCE LEVELS

The last three are in the feebleminded class, the upper three, because of the undependability of the mental age units, are usually recorded in terms of scores on particular tests.

M.A.	Classification	I.Q.	Per cent of Population
	genius	175 and above	
		150–174	1
	very superior	130–149	
(19–21)	superior	120–129	5
17.5–19	bright	110–119	14
14.5–17.5	normal, average	90–109	60
13–14.5	dull, backward	80–89	14
11–13	borderline	70–79	5
8–11	moron	50–69	
4–8	imbecile	25–49 feebleminded	1
1–4	idiot	0–24	

If a child is tested and his I.Q. is found to be in one of these groups, in subsequent testings it will in all probability be discovered to be in the same grouping or very close to it. Variations of as much as five points or so either way are fairly common; but when they are more than that, there has probably been some error in the testing, the child has not cooperated in one of the examinations, or there has been some decided change in his environment, like instruction in reading, which has improved his performance. Young children from cultured homes often test higher upon entering school than they do later, because of their early advantage over the majority of children. Since the I.Q. remains relatively constant throughout the life

of the individual, it is thus possible to predict with considerable accuracy what the academic achievement of a child will be. The possibilities lying in such prediction have been worked out by Terman, who translated and revised the 1911 scale for American use, naming it the Stanford-Binet Intelligence Examination. He writes as follows:[8]

> The typical child of 60 or 65 I.Q. tends to remain in the first grade until the age of ten or eleven years, and not to reach the fifth grade until the age of fourteen or fifteen years. By this time he has a mental level of only about nine years and is not able to do the school work satisfactorily above the third or fourth grade.
>
> The typical child of 75–79 I.Q. reaches the fifth grade by the age of thirteen years, and if he remains in school is likely to be found in the eighth grade by the age of sixteen or seventeen. Nearly always, however, his grade location is higher than the mental age would warrant.
>
> Children of 80–84 I.Q. usually remain two years in the first grade, and complete the eighth grade, if they complete it at all, one or two years behind schedule time.
>
> On the other hand, children of 120–129 I.Q. are usually found either one or two grades accelerated (on the basis of their C.A.). Nearly all of this gain, however, is made in the first year or two of school life. After the first year, they are held to the one-grade-one-year pace for average children. Even so, the central tendency is for them to complete the eighth grade at the age of thirteen.
>
> The situation is slightly but not proportionately better for the I.Q. group of 130–139. Children of 140 to 170 I.Q. however, are likely to become three or four years accelerated and to reach the eighth grade by the age of eleven or twelve years Wherever children of the higher I.Q. groups are located, their work always presents a striking contrast with that of children of 60, 70, or 80 I.Q. class who are several years their seniors.

In the Binet scale, the tests involve such tasks as the following:

Vocabulary — giving the meaning of certain words
Copying designs from memory
Description and interpretation of pictures
Repetition of digts, forward and backward
Similarities — seeing analogous relationships
Reading and report of a prose passage
Differentiating abstract words
Arithmetical reasoning

Such tests as these have to be administered to one child at a time, and about an hour is usually needed for the whole examination. This procedure is costly in time and money if many children are to be tested.

Group tests. The group test was therefore evolved, and came into prominence with the entrance of the United States into the World War, when the men drafted for military service were given the so-called Army Alpha Intelligence Examination. By means of the group test a large number of people can be tested at the same time. Obviously the form had to be altered in such a way that a record could be made of their performance. Thus the *timed test* was introduced consisting of a number of problems of the same kind, which the subjects are given a certain length of time to do. The score, then, consists of the number of problems completed correctly when time is called.

In the group intelligence examination the tests involve such tasks as the following. An example is shown in each case.

Arithmetic problems
A pencil costs five cents; how many pencils can I buy for thirty cents? ( )
Synonym — antonym
deplete . . . exhaust same . . . opposite
Disarranged sentences
This a under sentence line draw

Analogies
Corrupt is to *depraved* as sacred is to
(1) *Bible* (2) *hallowed* (3) *prayer* (4) *Sunday* ( )
Best reasons
Why do we use stoves? Because
(*a*) They look well
(*b*) They keep us warm
(*c*) They are black ( )
Directions
Draw a circle around this sentence.
Sentence completion
George is in the fourth ... . in school.
Information
A Zulu has (1) two (2) four (3) six (4) eight legs ( )

Group tests [9] have been devised for all ages from the kindergarten through college and have proved very useful in the rapid classification of large groups. A single test should not be relied on too heavily, however, in diagnosing individual cases, for the chances of erroneous results are far greater than in the individual test.

Non-verbal tests The Stanford-Binet, as well as the usual group intelligence tests, depends rather largely on the use of language. In fact the Stanford-Binet Vocabulary test gives more nearly the same results as the total examination than any other one test. But it is sometimes necessary to test individuals who have no command of English, either small children or those of foreign extraction. For this purpose non-verbal scales have been developed, the first group test of this sort being the Army Beta Intelligence Examination. Non-verbal tests [10] in which the directions are given orally are in use for preschool, kindergarten, and primary children, who respond by some kind of simple marking on the test blanks; for example, by drawing in missing parts, or following directions by marking in various things in line drawings according to directions.

Performance scales [11] are also devised in which no verbal directions are necessary. The examiner shows the testees what to do by gesture and pantomime, and they respond, for example, by putting together standardized puzzle pictures and form boards, which latter provide for fitting different-shaped blocks into place. Performance tests may be used for testing foreigners, the deaf, and any whose opportunities for gaining a facility in the use of English have been meager. The results compare very favorably with those obtained by the verbal tests.

4. INTELLIGENCE DIFFERENCES IN SCHOOL

Educational diagnosis. The most important single use of intelligence tests is for the *classification* of pupils in their proper grades in school. This can be done fairly satisfactorily by guesswork, but the test often makes it unnecessary to try a pupil out in a grade until he fails. Grade requirements or work materials are adapted to different intelligence levels; so on the basis of intelligence scores pupils can be placed in proper sections or special classes as their needs dictate. Many schools use A, B, and C groupings of intelligence instead of the mental age or test score, on the pupil records, dividing the children into rough categories for grade placement.

Often a more careful study of a pupil's needs has to be made because of his own peculiar academic difficulties, in which case in addition to the score he obtains on the regular survey test, additional intelligence tests, perhaps individual ones, are given as well as achievement tests in school subjects. Such measures make possible a better *diagnosis* of the pupil's handicaps, and lead to a more satisfactory treatment of his case.

Heterogeneous grouping. The old methods of promotion set up fairly rigid curricular demands for each grade, and the

great mass of the pupils "passed" from one grade to the next each year. The poorest were not allowed to pass, and became "repeaters," but the system was supposed to furnish an incentive for work, as it probably did However, a great many poor pupils passed, and the bright ones had to proceed at about the rate set by the average, which resulted in what has been called the "educational lockstep."

Each grade was made up of a heterogeneous group of pupils, intellectually, ranging all the way from very dull to very bright, and the teacher was expected to instruct them all. This proved to be no easy task. The teacher could instruct the brighter ones, leaving the others discouraged and hopelessly behind, or work with the dull on the theory that the bright could get the work anyway. They often did, with plenty of time left over for devilment. Or instruction could be aimed at the average, leaving the bright and the dull hanging in the air.

Homogeneous grouping. This awkward situation led to various experiments in grouping pupils according to their several abilities, in which the rapid development of intelligence tests during the last score of years aided materially. Grades are now often divided into fast and slow groups or X, Y, and Z groups, with requirements which temper the wind to the shorn lambs.

At first there was considerable opposition to the move. There was talk of "educational determinism," by which it was meant that the school by its program determined what the child should do, as if it was the school that allotted the brains to the pupils. It was thought that placing a pupil in a fast group would make him conceited, as of course it might; but the competition with others of like ability proved a sobering influence after he had always been so much smarter than the others. It was thought that a pupil would not like to be classified in "the dumb group"; but it was found that often they

do not know what group they are in; and they appreciate having tasks that they can do.

Teachers complained a bit at having their best pupils taken away from them, finding "the class" less spontaneous in its responses. The "pacemaker theory," by which bright pupils set the pace for the others, is apt to be discouraging rather than inspiring, and with the bright pupils by themselves the teacher is brought to realize the needs of the more unresponsive class members.

Homogeneous grouping provides for a better adaptation to the requirements of pupils of different intelligence levels; for the dull, a minimum of formal requirements, slower progress, and opportunities for various kinds of manual work in which they cannot be expected to excel, but in which they can at least do a number of interesting things well.

For the superior, the objectives vary between *acceleration* and *enrichment.* Should they do the regular things faster to give them time for the post-graduate training many of them will take; or should they go at the regular rate, but dip more deeply into correlated readings in literature and history, take music lessons, and participate in outside activities, so as not to be "too young" when they get to college? The problem has to be decided in individual cases, but the trend now seems to be in the direction of some acceleration and considerable enrichment.

Individualized instruction. Many feel that homogeneous grouping does not go far enough in the direction of the better adaptation of the schools to the needs of the pupils. Various plans have been worked out with the aid of individual study materials which enable the pupil to proceed at his own rate in the regular school subjects and provide for social and recreational activities in natural age groups. The Dalton school [12] in New York City has had many followers, as have the schools

of Winnetka, Illinois. The curricula and methods employed in these and other progressive schools are constantly undergoing revision, and tend to serve as a guide for school reorganization in other places.

Summary. The ability of people to attain their goals and surmount the barriers which impede them is determined largely by the level of their intelligence. Differences in intelligence have long been recognized, particularly as they relate to the ability of the individual to compete with his fellows on the economic level. Intelligence is related to learning ability, rate of mental growth, and to the capacity to adjust to new situations or to meet life problems satisfactorily.

Efforts to measure intelligence have finally eventuated in individual, group, and performance tests which make possible a more rapid and satisfactory classification of children for instructional purposes. When the various intelligence levels are known, the problem still remains of making the best use of this knowledge. In general, the old, heterogeneous grouping has given way to homogeneous grouping, special promotion devices, and schemes for the individualization of instruction.

QUESTIONS

1. Visit an institution for the feebleminded and observe the school instruction there given. If this is impossible, visit a school or a grade where there are dull normal or feebleminded children. How does the instruction and their performance differ from what you are accustomed to?
2. Do you know any students who entered college at fifteen or sixteen years of age? Do you think it would have been better for them to have waited a year or two before entering? Do they think so? How could they have spent those two years profitably?
3. In what ways do you think the school you attended was unfair to the backward? to the superior? What means were employed for adapting to these groups?

4. What pseudo-sciences have you come into contact with through advertisements, the radio, or actual practitioners? Describe and criticize.
5. Supposing there were no intelligence tests. Would you be able to pick the bright, average, and dull pupils in a grade? How would you go about it?
6. What advantages do tests have over other methods of grading intelligence?
7. How do you distinguish between intelligence tests and achievement tests in school subjects?
8. If $IQ = \frac{MA}{CA}$, what does MA equal?
9. List arguments for and against homogeneous grouping.
10. Indicate your views in regard to acceleration and enrichment for your mentally superior younger brother or sister.

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   The last mentioned volume is the guide to the administration of the new revised Stanford-Binet Tests of Intelligence. This revision contains two equivalent forms, extends to higher and to lower intelligence levels than the former revision, employs a correction table for computing the I.Q. of the higher chronological ages, and embodies a number of other improvements

9. On the elementary school level, the following group intelligence tests are widely used. Otis Primary Examination, Haggerty, Delta 2, Dearborn Intelligence Scale, and the National Intelligence Tests. On the secondary level, the following: Terman Group Test of Mental Ability, Miller Mental Ability Test, Detroit Advanced Intelligence Test, Thurstone Psychological Examination, Thorndike Intelligence Examination, and the I E R. (Institute of Educational Research) Intelligence Scale CAVD These letters stand for Completion, Arithmetic, Vocabulary, and Directions, the four types of tests of which the examination is made up.

10. Examples are the Merrill-Palmer Scale, Gesell's Development Schedules, and the Buhler Tests for Infants, on the pre-school level; on the kindergarten-primary level, the Pintner-Cunningham Primary Mental Test, the Pintner Non-Language Primary Test, the Detroit First Grade Intelligence Test, and the Haggerty Delta 1.

11. The Pintner-Patterson Performance Scale and the Drever-Collins Performance Scale are examples of these. See Bronner, Healy, Lowe, and Shimberg, *A Manual of Individual Tests and Testing*, Boston, Little Brown, 1928, also F. L Wells, *Mental Tests in Clinical Practice*, Yonkers, World Book, 1927.

12. Helen Parkhurst, *Education on the Dalton Plan*, New York, Dutton, 1922; Marie Montessori, *The Montessori Method*, New York, Stokes,

1912; C. W. Washburne, *Adjusting the School to the Child*, Yonkers, World Book, 1932; C. W. Washburne and M M. Stearns, *New Schools in the Old World*, New York, John Day, 1926; and J. W. Wrightstone, *Appraisal of Newer Practices in Selected Public Schools*, New York, Teachers College, Columbia University, 1935.

Both Parkhurst and Washburne owe much to Montessori in the development of their plans of individualization of instruction, though the Montessori "system" has been largely superseded. Wrightstone describes characteristics of old and new type organization to be found in the schools today.

Passages relating to intelligence are to be found in chap. V of *Readings in Psychology*, and in chap. XVIII of the *Readings in Educational Psychology*. The development of the Binet Scale and the Army Alpha examination is described in chaps. I and II in *Great Experiments in Psychology*.

CHAPTER VI

MEASUREMENT

Representing a distribution. Measurements of the intelligence and achievement of large numbers of pupils have forced the development of various ways of handling the scores. One or two pupils could be measured or perhaps a dozen or more, and the results considered individually, but in the case of a measurement program involving hundreds or thousands of pupils, chaos would be the result without means of bringing the scores together in some comprehensible fashion. Even individual scores need to be interpreted in comparison with the performance of other children. So various graphical and statistical methods[1] have been worked out to simplify the presentation and interpretation of test results

I. HANDLING THE RAW DATA

Ranking. Scores which pupils make on a test, like any other biological measurements of individuals such as height or weight, are scattered or *distributed* all along the scale from low to high. The test papers with the pupil's score written on each, or a list of names of pupils, each with his score written after it, constitute the raw data of measurement. They are what is "given," before the scores have been combined, and they don't mean much until they have been manipulated in such ways as to show the relationships which may exist between them. For example, if a pupil learns that he has made a 100 on a standardized test, he cannot tell whether this is good or poor, even if he knows the highest possible score, until

he knows what some of the other scores are. It may be the highest or the lowest or somewhere in between.

The simplest thing to do, especially if there aren't very many scores, is to rank them, that is, to arrange them in order from the lowest to the highest. This can be done, if one has the test papers, by piling them up with the lowest score on the bottom, the next one on top of it, and so on, until the paper with the highest score is on top. Otherwise, one arranges the scores in order, giving the highest the rank of 1, the next highest, 2, and so on.

If two or more persons happen to get the same score, they are all given the same rank. Thus, for example, in Table 2,

TABLE 2. SCORES ON FORM A OF A MENTAL TEST ARRANGED IN RANK ORDER

Score	Rank	Score	Rank	Score	Rank
110	1	101	12	90	21
108	2	101	12	89	22
107	3	101	12	87	24
106	4	100	14	87	24
105	5 5	99	15	87	24
105	5.5	88	16	85	26
104	7	97	17	83	27
103	8	94	18.5	81	28
102	9.5	94	18 5	80	29
				77	30
102	9 5	91	20	68	31

which shows some scores arranged in rank order, the 5th and 6th persons scored 105, so they are both given the rank 5.5, and the 7th person is given a rank of 7. Similarly, the 11th, 12th, and 13th persons scored 101, so they are all given a rank of 12 and the 14th person a rank of 14, and so on. Now the position of a score of 100, 14 in the class of 31, stands out clearly; and so do all the other scores down to rank 31, the

lowest of them all, the total number of students in the group.

Sometimes scores are presented according to *percentile ranks*. When this is done, a *percentile score* is interpreted on the basis of a group of 100. If a person gets a percentile score of 85, for example, this would mean that out of a hundred people of his level — college sophomores, or seventh grade pupils, or whatever the case might be — there would be 15 above him and 84 below.

Grouping. When there are more than 20 or 30 scores to be handled, it is usually easier to group them. If this is done, one finds how many scores there are in the interval 60 to 69, 70 to 79, 80 to 89, etc. (or 60 to 64, 65 to 69, 70 to 74, etc.). These numbers represent the *class interval*, which can be 10 or 5, as in the illustration, or 3, or 20, or any number to make a convenient grouping. If we have a row of scores as in Table 3,

TABLE 3. SCORES ON FORM B OF A MENTAL TEST

Score	Score	Score
85	94	91
101	96	84
102	77	81
96	84	85
102	96	81
85	112	87
101	78	83
88	95	105
95	86	83
95	75	88
		101

and select a class interval of 5, the number of scores in each class interval (first column, Table 4), may be tabulated, one score at a time by tallies (second column, Table 4). The tallies for each class interval are totaled in the frequency column.

It is because the numbers in this right-hand column indicate

how many times, or how frequently, certain scores are made that they are called *frequencies*; and the table (without the tallies) is called a *frequency table* or a *table of frequencies*, a *distribution table*, or a *frequency distribution*, because it shows how the scores are distributed from low to high.

TABLE 4. TABULATION SHEET

Scores	Tabulation	Frequency (f)
110–114	/	1
105–109	/	1
100–104	~~////~~	5
95–99	~~////~~ /	6
90–94	//	2
85–89	~~////~~ //	7
80–84	~~////~~ /	6
75–79	///	3
		N = 31

The relation of the scores to each other now shows very clearly. It would be possible to assign letter grades to them if one so desired. This would have to be done rather arbitrarily, it is true. But the arbitrariness is not due to the more exact measures. It is merely that more exact measurement reveals the arbitrariness of a marking system.

Note that as always happens in any group, the larger frequencies are found toward the center, with fewer scores toward the ends of the distribution. This gives a cue to the general appearance of the graphical representation of a distribution.

2. GRAPHICAL REPRESENTATION OF A DISTRIBUTION

The histogram. Often a picture makes things clearer than a row of numbers. It is possible to graph[2] a group of scores in such a way that one can tell at a glance how they distribute

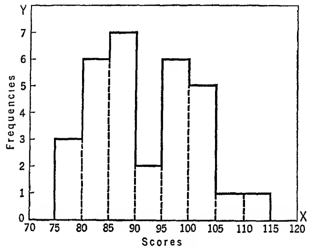

FIG. 9. A HISTOGRAM
(Drawn from the data in Table 4.)

themselves along the scale. This can be done in different ways by means of a histogram, a frequency curve, or a percentile curve. The height of the columns of the histogram (Fig. 9) represents the numbers of scores in the class interval at its base. The piling up of scores in the center of the distribution shows very clearly in the histogram, as do the small number of high and low scores.

The frequency polygon. Another common method of representing a distribution graphically is by the use of a *frequency polygon* (see Fig. 10). This figure is also called a *surface of frequency* or a *frequency curve.* It is constructed by connecting what would be the midpoints of the top horizontal lines of the histogram, if it were drawn.

Either of these figures may be used, though the frequency polygon is probably more often found in educational writings. Notice that each shows at a glance the somewhat irregular dis-

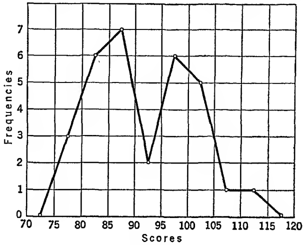

FIG. 10. A FREQUENCY POLYGON
(Drawn from the data in Table 4.)

tribution of scores of *this particular group of students*. Fig. 11 shows a convenient method of comparing distributions by superimposing one curve upon another. Here we have separate curves in a case in which the same students have taken two different forms of the same test.

The curve for Form A in Fig. 11 is not at all symmetrical, with the greater number of scores at the right, the others sloping off irregularly to the left. It is therefore said to be *skewed to the left*, or *negatively*. If the low-lying portion had been at the right, it would be *skewed to the right*, or *positively*. Figs. 12 and 13 show the characteristics of *skewness*.

Sometimes the curve is almost symmetrical with its high point in the center falling away gradually at each side. Figs. 14, 15, and 16 are such curves, one representing mental ability, a second physiological growth, and the third the chance fall of pennies.

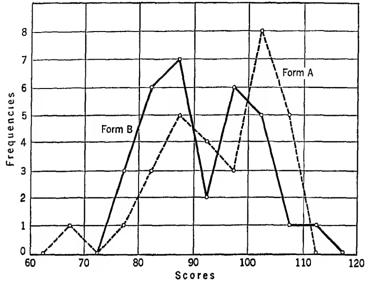

FIG. 11. FREQUENCY CURVES TO COMPARE THE DISTRIBUTIONS OBTAINED BY GIVING TWO FORMS OF THE SAME TEST TO THE SAME STUDENTS

The probability curve. Figs. 14, 15, and 16 approximate the mathematically drawn *probability curve* (Fig. 17), which is variously called the *curve of chance, normal curve, theoretical probability curve, bell-shaped curve,* and *curve of Gauss.*

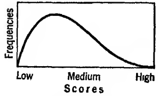

FIG. 12. POSITIVE SKEWNESS
To the right.

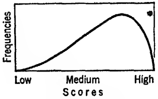

FIG. 13. NEGATIVE SKEWNESS
To the left.

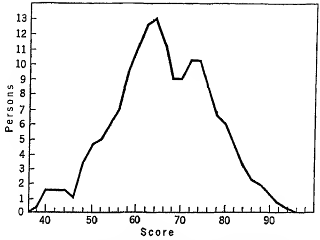

FIG 14. DISTRIBUTION OF ABILITY IN THE A-TEST

Based on 164 university students. The horizontal axis represents the number of A's crossed out in one minute; the vertical axis represents the number of persons of each ability. (After Starch.[3])

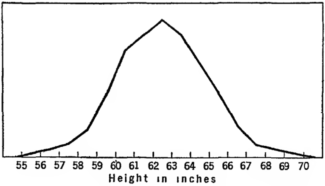

FIG. 15. DISTRIBUTION OF THE HEIGHT OF 1052 WOMEN

The horizontal axis shows the height in inches, the vertical distance above it indicates the frequency (After Starch [3])

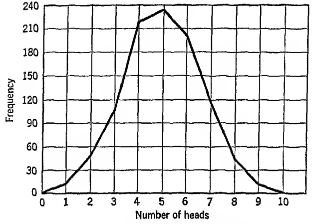

FIG. 16. DISTRIBUTION OF THE NUMBER OF HEADS UP IN TOSSING TEN PENNIES AT ONCE 1000 TIMES

The horizontal axis gives the number of possible heads up in each tossing; the vertical axis gives the number of times each number of heads was up. (After Starch [3])

The normal curve represents one of the most significant principles in all biology, that of probability. Nature seems to aim at a target, as it were, misses often, but the hits are more frequent as represented by the piling-up of the scores in the center. There are no skips. Tall men, men of average height, and short men exist only as arbitrary boundaries are set; for who shall say where the height of the average men leaves off and that of the tall men begins! At five-feet-eight, -ten, or six feet? Similarly, the people in the population at large do not in reality divide into separate groups to be designated as the bright, the average, and the dull. If they did, there would be no normal curve; the "distribution" would look like Fig. 18. Thus, there may be "types" or "ability groupings," but they are merely arbitrary divisions made for convenience.

The percentile curve. A quite different form of curve can

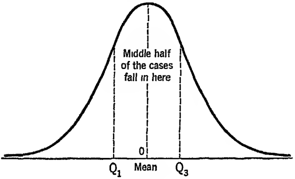

FIG. 17. THE THEORETICAL PROBABILITY CURVE

be drawn from data when they are arranged in the form of percentile ranks. This is the percentile curve. For some purposes it is more convenient than the frequency curve, for one can read from it the position of any score in per cent as well as get a picture of the whole distribution. Also, several curves can be drawn on one graph without confusion.

For the percentile curve, the scores are arranged on the vertical line, and the horizontal line is the per cent scale numbered to 100. The percentile curves drawn below (Fig. 19) represent the distribution of intelligence scores of different academic groups. Note the different scores obtained by the middle pupil (50 percentile position) of each of these groups.

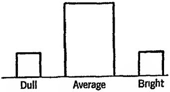

FIG. 18. HYPOTHETICAL "DISTRIBUTION" OF TYPES

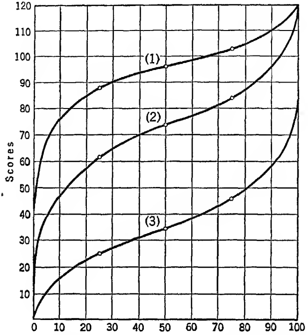

FIG. 19 PERCENTILE CURVES SHOWING A COMPARISON OF INTELLIGENCE OF DIFFERENT GROUPS

(1) Applicants for a teacher's certificate, (2) high-school seniors; (3) seventh grade pupils. (The median and quartile points are marked with small dots.)

3. CENTRAL TENDENCY

The arithmetic mean. Scores may be ranked, arranged in a frequency distribution, or presented graphically. But still there is need of a single *number* to represent an array of scores. One such number is very familiar to everyone. It is the mean (often referred to as the *average*) obtained by dividing the sum of the scores by their number. It is known more accurately as the *arithmetic mean*, and is in many ways the most satisfactory

statistical measure to show the *point in the scale around which the scores tend to cluster*. It is therefore called a measure of central tendency.

The median. Another measure of central tendency, the median, is equally useful, and can be found much more easily *by counting*. All one has to do is to take the *ranked scores*, and count one-half the way down to the *middle score*. If there is an even number of cases and hence no middle score, take the point halfway between the two middle ones. The median, then, is the point (score) above and below which are an equal number of cases when they are arranged in rank (ascending or descending) order.

The mode. There is still another common measure of central tendency called the mode, which may be obtained simply *by inspection* of the frequency curve or table. It is the high point of the curve, the score obtained by the greatest number of people — the score of highest frequency in the distribution. It is read off from the horizontal axis and is the midpoint of the class interval beneath the highest point of the frequency curve or of the histogram. In the frequency table, it is the score at the midpoint of the C.I. (first column) having the largest frequency (second column) after it.

Recapitulation. Three numbers, each representing a *point* on a scale, the mean (or average), the median, and the mode, are really three indicators of the same thing; namely, the central point about which the scores have a tendency to cluster. It is for this reason that they are called *measures of central tendency.* The term average is sometimes used to refer to any measure of central tendency as well as to the arithmetic mean.

4. VARIABILITY

The range. If you learn that the median score of a ninth grade in an arithmetic test is 10, you would not know whether all the pupils scored close to 10 (homogeneous group) or whether they were scattered, with a few very high scores and some low ones (heterogeneous group). In Table 5, and also in Fig 20, we have an illustration. The median in each case is 10, but the constitution of the two groups is obviously very different.

TABLE 5. TWO GROUPS WITH THE SAME CENTRAL TENDENCIES BUT DIFFERING VARIABILITY

Score	Group I f	Group II f
18–20	0	3
15–17	0	4
12–14	8	5
9–11	15	6
6–8	7	4
3–5	0	5
0–2	0	3
	N = 30	30

Group II has several pupils who score above and several who score below those in Group I. Clearly some other figure than the central tendency is needed to present such facts as these. The common one is the range. We can say that the scores in Group I range from 7 to 13, or have a range of 6 (13–7) while those in Group II range from 1 to 19, or have a range of 18. Or we might refer to the original score sheets or raw data to see exactly what the scores are, instead of trusting to the midpoints of the extreme intervals. The difference can be shown compactly in tabular form thus:

TABLE 6. TABULATION FROM TABLE 5

	Group I	Group II
Median	10	10
Range	6	18

However, if one pupil in Group I had scored 1 and another 19, the range of both groups would have been the same. Thus, the range does not fairly represent the distribution because it is so dependent upon the presence or absence of the highest and lowest individuals; hence it is said to be an *unstable measure.*

The average deviation. This difficulty can be avoided by using some other measures of variability. One of these is the average deviation, abbreviated A.D., sometimes called the *mean deviation*, abbreviated M.D. or *mean variation*, abbrevi-

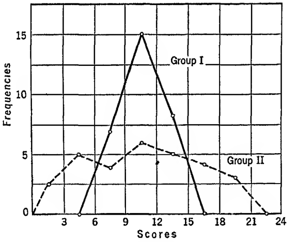

FIG. 20. CURVES OF TWO DISTRIBUTIONS WITH THE SAME CENTRAL TENDENCY, BUT DIFFERING IN VARIABILITY

ated M.V. The principle of this is simple. Suppose seven people took a test and received the following scores, 2, 5, 5, 6, 8, 10, 11. The median or middle score is 6. The best score is 5 points above the median, the worst is 4 points below. Similarly, we can figure the distance that each is above or below the median. In Table 7 the scores are listed in the first column, and the distance or deviation of each from the median in the second. It is easy, then, to add the deviations arithmetically, that is, without regard to signs, and divide by the number of scores and so get the average deviation:

TABLE 7. AVERAGE DEVIATION

Scores	Deviations
11	5
10	4
8	2
6	0
5	−1
5	−1
2	−4
	17

$$\text{A.D.} = \frac{\text{sum of the deviations}}{\text{number}} = \frac{\Sigma d}{N} = \frac{17}{7} = 2.43$$

If a similar group showed an average deviation of 3.5, the latter would be more scattered or heterogeneous. In a normal distribution, if the A.D. is laid off on each side of the median, the middle 57.5 per cent of the cases making up the distribution will be included.

The standard deviation. Abbreviated S.D., or σ (sigma), the standard deviation is another measure of variability. It is like the A.D. except that it is obtained by squaring the devi-

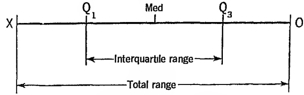

FIG. 21. THE RANGE AND QUARTILE DEVIATION

ations to get rid of the minus signs before they are added and then extracting the square root of the sum. In a normal distribution, if the S.D. is laid off on each side of the mean, the middle 68.26 per cent of the cases making up the distribution will be included.

The quartile deviation. Perhaps the most convenient measure of variability is the quartile deviation or *semi-interquartile range,* as it is sometimes called, abbreviated Q. These names should not obscure the fact that this measure like the A.D. and S.D. also represents a *distance* on the scale, albeit only a part of the total range. Q is the range of scores of one-half the middle fifty per cent of the group.

When the median or fifty-percentile point is found, each of the halves of the distribution is then divided in two in the same way, so that the total distribution is then divided into quarters with the same number of persons (or scores) in each quarter. The lowest of the three dividing points is called the first quartile (Q_1), the middle one is the median, and the upper one is the third quartile (Q_3). The distance from Q_1 to Q_3 is the middle half of the range of scores (called the interquartile range), and half this middle range is the quartile deviation (Q). Thus if the ranked scores are thought of as extending from X to O in Fig. 21, XO is the total range, and Q_1Q_3 is the interquartile range. This may be represented as $Q_3 - Q_1$ (Q_3 being the top of the range of scores from X to Q_3 and Q_1 being the top of a

range of scores from X to Q_1). The semi-interquartile range or quartile deviation (Q) is thus,

$$\frac{Q_3 - Q_1}{2}.$$

It can be seen that this is a much more stable measure than the total range, because, if one or two or three people were absent around the quartile points, those left would have so nearly the same score as to make no appreciable difference; whereas there is apt to be a wide scattering toward the ends of the distribution.

This dividing of the distribution by quartiles serves another purpose than that of measuring the extent of scatter or variability of one group in comparison with another. It makes a convenient way of estimating the position of a person in a group, and hence of determining the degree of excellence of his mark. To say a pupil got a score of 47 in an arithmetic test, in itself means nothing; but to say he was above the third quartile indicates that at least seventy-five per cent of the students were below him — something quite definite.

The percentile score. Similarly, the distribution can be divided in any convenient fashion, into fifths by *quintiles*, tenths by *deciles*, or in the case of large groups, into hundredths by *centiles*, also called *percentiles*. It is quite common practice, now, to give a child a percentile score or rating, which means the actual percentage of children who were below him in a large group.

The percentile curve, which shows these relations, has already been mentioned in connection with the discussion of methods for representing a distribution graphically (see Sec. 2 and Fig. 19).

The manner of describing the curve becomes clearer now, for Q_1 (the twenty-five-percentile point), the median (the fifty

percentile point), and Q_3 (the seventy-five-percentile point) can be located at once, as can also the highest and lowest scores. With these five points given, it is possible with a little practice to draw the curve with considerable accuracy. If greater accuracy is desired, decile points may be computed and located, and a curve drawn connecting them.

The other positions may be read from the curve (as in Fig. 19).

Recapitulation. Four figures each representing a distance on a scale, the range, average deviation, standard deviation, and quartile deviation, are really four indicators of the same thing; that is, the extent to which the scores *vary* in their nearness to the central tendency — their spread or scatter. Hence they are called *measures of variability*. Also, the points marking off different distances can be used to indicate the relative position of individual scores.

5. CORRELATION

Coefficient of correlation. Again it will be convenient to have some one figure which will represent the extent to which those pupils who do well in one respect, say on an intelligence test, also do well in another respect, such as in school marks. There is such a figure, called the coefficient of correlation. This coefficient ranges from $+1.00$ through zero to -1.00. *Perfect positive* correlation is indicated by $+1.00$, which means that the person who gets first place on one test gets first on the other; the one who gets second on one gets second on the other; and so on through to the last on one who gets last on the other. Of course, this rarely if ever happens. Similarly, -1.00 is *perfect negative* correlation, which means that the first on one test is last on the other; the second on the one is next to the due last on the other; and so on through to the last on the one who

gets first place on the other. Such cases are equally rare. *Zero correlation* means no correlation at all, no relationship between the scores. There would be no (or very low) correlation, for example, between intelligence and the number of letters in people's names. Intermediate points in psychological and educational tests are regarded somewhat as follows:

.80 to .95 very high
.60 to .80 high
.40 to .60 substantial
.20 to .40 low
.05 to .20 very low

Perhaps more meaning may be given to these coefficients by indicating some correlations which have been found between measures of intelligence and of school performance:

.94 Stanford-Binet with itself.
.91 Vocabulary age and mental age.
.84 Stanford-Binet with Dearborn Form Board, Grade I.
.65 Average of school marks and entrance examination marks with Harvard freshman marks.
.59 Thorndike Group Intelligence Examination with Columbia freshman marks.
.58 Stanford I.Q. with Porteus Maze, Grade I.
.50 College entrance examinations with Harvard freshman marks.
.43 College entrance examinations with Columbia freshman marks.
.41 Stanford-Binet and fundamental processes in arithmetic test
.36 Group intelligence examination and marks in handicraft.
.31 Thorndike intelligence examination with Bryn Mawr freshman marks.
.27 Pressey intelligence test and Burgess reading test.
.21 Stanford-Binet with school marks in writing.
.21 Stanford-Binet with school marks in drawing.
.13 Test scores and alphabetical arrangement of names.
.003 Binet mental age and scores in handwriting.

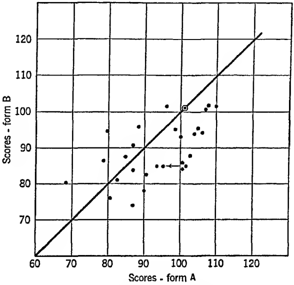

FIG. 22. SCATTER DIAGRAM

Each dot is a pupil's score, in Form A read on the x-axis, in Form B on the y-axis Here, $r = +.59$.

It can now be seen that intelligence is a *variable*, just as temperature, wind velocity, birth rate, and school marks, handwriting ability, and reading scores are variables. They are present in varying amounts which can be more or less accurately measured. A coefficient of correlation, then, is a figure which shows the degree of relationship between variables.

Probable error of a coefficient. The more cases that are studied, the more representative and dependable the correlation is. What is called the probable error of a coefficient of correlation is used to express the extent of this dependability. If the coefficient is less than three times the probable error, it is

not dependable. The abbreviation for probable error is P.E. Often the probable error follows the plus-or-minus sign: $r = .52 \pm .03$. This means that the chances are even that the true coefficient of correlation would (or would not) be between .49 and .55.

The scatter diagram. A good way to get a general idea of the nature of the relationship of two variables is by the use of a scatter diagram (see Fig. 22).

The scale (scores) for one variable is marked along the vertical line and for the other along the horizontal line. Each dot represents a pupil, and it is so placed as to show his score on each test. For example, Pupil 1 scored 94 on Form A and 85 on Form B. Above 94 is a dot (with an arrow pointing to it) at the height of 85 on the vertical scale. Similarly, for Pupil 2, who got the same score on both tests, there is a second dot (with a circle around it) above 101 and on a line with 101. In like manner the other dots are allocated.

Notice that the dots tend to fall along the diagonal. The more nearly they form a straight line, the more nearly perfect is the correlation. The more they scatter, the lower the correlation. If they tend to take places along the other diagonal, the correlation is negative (Fig. 23).

An added value of the scatter diagram is that it makes possi-

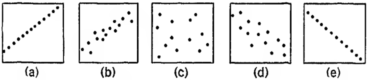

FIG. 23. POSITIVE AND NEGATIVE CORRELATION SHOWN BY SCATTER DIAGRAMS

Hypothetical cases (read as in Fig 22) to show the meaning of possible variations. The correlations may be approximated as follows: (*a*) perfect positive; (*b*) high positive; (*c*) no correlation; (*d*) high negative, and (*e*) perfect negative (After Thurstone [4])

ble an analysis of the scores. For example, it calls attention to the deviates. A dot all by itself away from the rest, if not due to an error, may indicate that the child is so unlike the rest that he needs special attention of some sort, perhaps encouragement, or individual instruction.

Recapitulation. In this section, various ways of handling large numbers of scores have been presented. Their purpose is purely instrumental; they have no ultimate value. Because a large number of separate items have little or no meaning, methods have been devised to represent such separate items graphically or by a single number. The measures are: central tendency (mean, median, and mode), variability (range, average deviation, quartile deviation, and standard deviation), and the coefficient of correlation.

6. THE STANDARDIZED TEST

Objectivity. The usual methods of marking pupils have been under fire in recent years because they are *subjective,* which usually means that qualified teachers would not be in agreement, and that the criteria upon which judgments are based are not well defined. A pupil who is clean, polite, well-behaved, and who tries hard is more apt to receive a good mark, whereas the opposite qualities are apt to be detrimental to scholarship records. How much the mark is due to academic achievement and how much to the personal qualities of the pupil, no one knows.

Teachers' marks are apt to be based in part on examinations, but these, as a rule, do not eliminate the subjectivity. What questions shall be asked? How important are they? What mark shall be given for various degrees of imperfection in the replies? The prejudices and moods and physical condition of the teacher have much to do with pupil success on ex-

aminations. When the trouble has been taken to have several teachers score the same paper, amazing differences in the mark given have been found, ranging all the way from 30 per cent to 95 per cent correct.

True, when a number of papers are read, and a scoring system agreed on beforehand, the differences in the markings of a paper are not so great.

Short-answer tests.[5] The so-called *new-type* or short-answer tests increase the objectivity of the mark at two points *sampling* and *scoring*. Since a larger number of items can be called for if the pupils are to check their answers, instead of writing them, such a test provides a larger sample, one which is more representative of a pupil's knowledge. And all who might score a paper get the same result, since it is merely a matter of checking the wrong or omitted answers with the aid of a *scoring key* and totaling the right ones. The following forms of short-answer tests (with samples of each) are frequently used:

The True-False Test.

Directions: Below are a number of statements some of which are true and some false. On the line at the left of each statement put a plus sign (+) if the statement is true and a zero (0) if it is false.

.... 1. Columbus discovered America in 1620.
.... 2. Portia is one of Shakespeare's great female characters, who appears in *Macbeth.*
.... 3. The French word for knife is *le couteau.*
.... 4. Its gender is masculine.

The statements of the true-false test should be brief (simple sentences are less apt to be ambiguous than complex or compound); this rule is violated in illustration 2, above. They should be independent of each other, which is violated by 4. They should be significant, not trivial, and about (not exactly)

half of them should be true and half false. This type of examination may also be given orally, in which case the pupils write the numbers in a column on blank paper and write each + or o after its proper number, each statement should be read slowly and clearly twice. There is some evidence that the false statements teach pupils misinformation; so the true-false test should be used sparingly.

Because a pupil could get about half the answers right by chance, even if he knew nothing about the subject, the true-false test is scored *right minus wrong* (R–W). That is, the number of wrong answers is subtracted from the number of the statements marked correctly. A short-cut method is to deduct from the total number of questions two for the wrong answers and one for the omissions.

The Multiple-Choice Test. The multiple-choice form of examination is also called the multiple-response or recognition test.

> *Directions:* Each of the statements below can be correctly completed by one of the four words which follow it. Find the one that makes the best answer and put its *number* on the short line at the right.
>
> 1. Columbus discovered America in (1) 1620; (2) 1492; (3) 1609; (4) 1066 1
> 2. Portia appears in (1) Macbeth; (2) Ivanhoe; (3) Bible; (4) The Merchant of Venice 2

The difficulty in constructing this form of test lies in the ingenuity necessary in thinking up four or more plausible alternatives within a limited field. The system of recording numbers at the right instead of underlining the correct response makes for more rapid scoring, but should not be used at age levels where it is too difficult for pupils to make such substitutions. The correct answer comes now first, now second, now fourth, and so on, in irregular order, so that the pupil will not

use its position as a false cue. The score is the number right.

The Best-Answer Test

Directions Put a check mark on the short line just before the best answer to each question.

I. Why did Columbus set sail? Because

... . 1. He wanted to discover America

.. .. .2. He sought a shorter trade route to India.

... .3. He was really a fugitive from justice

... ... 4. He believed that he could find a better route than Magellan had.

II. Portia is the character who

.... 1. Walked in her sleep.

.. . .2. Was queen of love and beauty.

. . ....3. Masqueraded as a lawyer.

.... 4. Married Jessica.

It can be seen that the best-answer type is really another form of the multiple-choice test, as is the one which follows.

The Matching Test

Directions: On the line at the left of each lettered phrase (in the second column) write the number of the term it defines or explains.

1. bacteria	. ..	a. Character in Shakespeare.
2. Columbus	... ..	b Part of a triangle.
3. hypothenuse	....	c. French word for knife.
4. le couteau		
5. Portia		

Although the diversity of terms makes these samples somewhat ridiculous, this is a very usable form for vocabulary tests for definitions of technical terms or identification of literary or historical characters. An extra item or so in either column cuts down the guessing factor on the last one or two doubtful items. The score is number right.

The Recall Test. In the forms presented thus far the pupils are asked merely to select the right answer from two (true-false test), or more than three given possibilities. As a rule

those who can do this are the ones who can also think of the right answer if it is not given, though this is more difficult.

> *Directions:* Complete each statement by writing the missing word on the line at the right.
> 1. Columbus discovered America in the year 1
> 2. Portia appears in 2

Great care must be taken in making out these examinations, for only statements for which there is but one correct answer in all the world can be used to advantage. The first is all right with "the year" in place, but without these two words many answers might be found such as "place," "time," or "desperation." Similarly, the second opens the way for all the school wits to do their worst. The score is number right.

> *The Completion Test*
>
> *Directions:* Think of the word that should go in the place of each number in the parentheses, and write it after that number in the right margin.

1. In the year (1) Columbus set out on his famous voyage in search of a shorter route to (2).	1......... .. 2...........
2. Portia appears in the play written by (3) named (4). She disguises herself as a (5), delivers (6) from the clutches of the (7) named (8) and then returns to her home in (9).	3 .... 4. .... 5... . ..... 6. ..... . 7. .... 8 .... 9........ ...

As in the multiple-choice test, the system of recording answers at the right facilitates scoring. On intelligence levels where this presents difficulties, however, children should be given test forms in which they may write the missing words in proper places.

The completion test is a form invented by Ebbinghaus. It

is subject to the same difficulty as the simple recall form, namely, avoiding statements which can be completed in more than one way. There is another danger as well, and that is the temptation to leave too many blank spaces, making it a rather hopeless puzzle for the pupil. The second example above leans decidedly in the direction of this fault. It is much easier to think of the right answers when one has made out the test than it is when some one else has!

Reliability. If you stepped on the scales one day and found that you weighed 120, and the next day 165, you would conclude at once that the scales were far from reliable. One expects to obtain the same amount from a measuring device in successive measurements of the same object. This is truc also of a standardized test.

There are various ways of measuring the reliability of a test. It can be given twice to the same group, and the coefficient of correlation found between the two results; or the scores of two forms of the test may be correlated, or (which amounts to the same thing) one half the test can be correlated with the other half.

Theoretically the *coefficient of reliability* so obtained should be 1.00, but owing to chance factors in testing it may fall short of this. The reliability of the Stanford-Binet is as high as any, being about .90 or .95, though one as low as .80 is considered satisfactory. Many tests which look good on the surface are found to be so unreliable as to be worthless.

Validity. When reading a thermometer, one has no fear that he may be getting a measure of barometric pressure or of the distance of his eyes from the instrument. But in measuring such closely allied variables as human qualities one is not so sure. For example, the usual essay-type examination may and does measure speed of handwriting, conciseness of expression, and prudence in selecting proper parts of the course

for careful study quite as much as it measures knowledge of subject matter or ability to organize one's ideas.

A test is valid if it measures what it is supposed to measure. But here a difficulty presents itself. How can one know whether a test measures intelligence, for example? There are two possibilities: compare the results with judgments, or with other measures of intelligence. While both may be in error, they are the only criteria there are. A high correlation with some recognized group test, or better, with the Stanford-Binet is usually a certificate of admission for an intelligence test. For other abilities or qualities a similar consistency with accepted measures or group judgments is sought. It may be found that a history test in reality measures intelligence; or a character test, memory!

Norms. If a test is given only to a grade or class or other small group, the position of each member who takes it can be ascertained with relation to the others; but it provides no means of knowing the standing of the group as a whole. In comparison with other similar groups, it may be very low. For this reason, standardized tests are provided with norms. The test has been administered to large numbers of persons at the various levels for which it is intended, and the central tendencies and variabilities or sometimes the percentile scores are found. For example, the percentile curve in Fig. 19 provides norms for the Miller Mental Ability Test. From achievement test norms, or standards as they used to be called, the superintendent or supervisor can tell how different groups in the system compare with what might be expected in scholastic abilities. Obviously, low intelligence groups would not be expected to do as well on subject-matter tests as others, while a mean score which is equivalent to the norm would indicate poor work for a superior group.

The standardized test. The standardized test, then, is one

which is objective (in giving and scoring). It has been subjected to procedures which show it to be reliable and valid, and norms of accomplishment at appropriate levels are provided for it. It is this instrument, approaching scientific objectivity and precision as it does, with which educational measurements are gradually making their contributions to a science of education.

Summary. Various means have been worked out to make masses of data more intelligible: graphical representation, measures of central tendency, and measures of variability. The degree of relationship between abilities or other variables is represented by the coefficient of correlation. Short-answer tests have been devised to increase the objectivity of examinations, which in their standardized form are dependable scientific instruments.

QUESTIONS

1. Show the fallacy in the statement: We do not want standardized tests in our school because we do not want our children standardized.
2. When would ranking the scores and when would grouping them in the form of a frequency distribution be more desirable?
3. What information can be obtained from a frequency polygon? from a percentile curve?
4. Distinguish the mean, median, and mode.
5. Distinguish *A.D.*, *Q.*, and *S D.*
6. Would it be possible to correlate the intelligence of the children in one school with that of the children in another school? What would be the best way to compare such groups?
7. What are the advantages of a short-answer test? the disadvantages?
8. When should teacher-made short-answer tests be used and when a standardized test? What are the advantages of each?

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CHAPTER VII

INDIVIDUAL DIFFERENCES

Uniformity and difference. Such methods of handling test scores as have been described in the preceding chapter have been very helpful in determining the amount of the differences in the nature and abilities of individuals. The various kinds of raw data obtained from measurements can be manipulated statistically for the comparison of people and groups. There are anatomical measures of height and weight, psychological measures of mental processes like reaction time and intelligence, and educational measures of school achievement, as well as social measures of socio-economic status, and many others.

Quantitative data are necessary for exact knowledge whatever the direction of the investigation may take. On the one hand, one may seek to learn more of the nature of man with a view to evolving the laws or principles of the human mind in any of its aspects, such, for example, as the sensory processes, imagery, remembering and forgetting, association, and the transfer of training, and so find out the ways in which people are alike.

Or, one may measure the amounts by which individuals differ in various respects. The results of the latter type of investigation aid those who are concerned with problems of human adjustment, and in the educational field reveal many of the individual aptitudes and needs for which the school must make provision.

Biological and social heredity. Probably the groups that seem to differ most strikingly are the races of man, largely because of differences in skin color and in social customs. The

former are true biological differences, while the latter are the product of tradition; but both differences are comparatively insignificant in comparison with the likenesses between races. An intelligent and cultured Chinese, for example, in many respects is more like a refined and well-educated Caucasian than he is like a backward or degenerate member of his own race.

It is therefore important to try to distinguish between those characteristics which are due to differences in the germ cell, and those which are the result of processes of social conditioning, like dress, religious beliefs, marriage customs, eating habits, and so on. A good way to get a realization of how customs can change and so make the different races seem more alike is to think of the members of these races one may know who have been born and brought up in America. But even here, the force of tradition and environmental conditions have tended to continue the culture of the parents.

Within any racial group, intermarriages have so mingled the different racial strains that there is practically no such thing as a pure race, biologically; while socially, a people tends to assimilate the culture of its time and locality. Thus the present White race, for example, divided as it is into numerous nationality groups, is a mixture of many strains resulting from migrations and military and commercial conquests, and modified by differing climatic, economic, political, and religious influences.

Racial differences. Biologically, the races are distinguishable primarily on the basis of skin color (or, if one follows another classification, by the shape of the head) and perhaps in average height, though the latter factor may be mostly a matter of selection. Psychological differences,[1] too, are not so great as was formerly supposed. Superiority in keenness of vision, hearing and smell, and speed of running of the

American Indian, for example, which has served boys' stories so long and well, is a myth arising from the observed skill of the Indians, developed from the outdoor life and experiences to which they were long habituated. For in sensory acuity and motor coordination savage races are neither superior nor inferior to others.

Whether the same is true of artistic feeling and talent has not been definitely determined. But it is certain that cultural factors are here very influential, as they are also in emotionality; and most certainly social attitudes and prejudices are learned. Whatever differences are found, then, may be true biological differences, or they may be due to social and environmental factors.

Intelligence differences. Racial psychology[2] involving actual measurement has thus far been largely confined to studies of intelligence, the most extensive of which grew out of the measurement of those drafted for the army in the World War. The intelligence scores of Negro and white recruits, for example, are shown in the histograms in Fig. 24.

Other testing programs show similar results, average Negro intelligence scoring consistently below the average intelligence of Whites, though with large overlapping. Thus it may be said in general that approximately 40 per cent of the Negroes score above the median of the Whites

These results should be interpreted with caution, however, because of other differences than those of race which enter in. A lower economic level does not provide the opportunities for mental development that a higher one does; though, of course, a lower economic level may in part be the result of lower intelligence.

If the results of verbal intelligence tests are to be comparable, the tests must be given to persons of equal educational opportunity. And this is rarely if ever the case among the

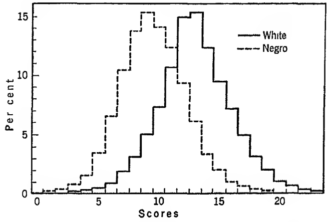

FIG. 24. DISTRIBUTION OF INTELLIGENCE SCORES IN TERMS OF A COMBINED SCALE OF THE WHITE AND NEGRO DRAFT[3]

White Draft, 93,965 cases, Negro Draft, 18,892 cases.

groups measured. The Southern states spend about one fourth as much per capita for the education of the Negro children as they do for the White. Hence the educational opportunity for the Negroes in the South may be judged inferior. While it may not be equal in the North, at least the intelligence scores of Northern Negroes more nearly approach the norm of the Whites. This may be due to educational factors, and it may also be due to selection, if the more intelligent Negroes tend to come North.

Japanese children in California are inferior to white children of the same age as measured by the Stanford-Binet. But the examination demands a facile use of the English language. In the non-linguistic tests on this scale, like the enclosed boxes, paper-cutting, and code tests, the Japanese children have been shown to be superior. In general, so far as testing conditions can be made comparable, Japanese, Chinese, and Jewish

children are approximately equal to American white children in intelligence, while the scores of Negroes and of American Indians range definitely lower.

Nationality differences. Intelligence tests of different European nationalities represented in America show rather wide differences, but here also, it is necessary to make interpretations cautiously. European immigrants have come to our shores at different times and for different purposes, and they and their descendants do not always fairly represent the nations from which they come. The Southern Europeans who came during the period of industrial development preceding the World War score lower on the average than the descendants of earlier immigrants from England, Germany, and France. But the later immigrants were recruited largely for unskilled labor in the factories, and therefore would in all probability have scored low at home. They do not constitute a random sampling of the nationalities to which they belong. In general, the English, Scotch, and Jewish populations in America test high, the Scandinavian and German about average, and the Italian, Polish, French Canadian, and Mexican (Spanish and Amerindian origin) a little below average.

Dependable comparisons of the intelligence of people speaking different languages have not yet been made because of the uncertainty about the equivalence of the translations of intelligence tests, the unequal educational and social experiences of the different groups, and the uncertainty which still surrounds the standardization of the performance tests.

Measurable sensory and motor functions show no differences as between the representatives of different national groups, while emotional and temperamental differences are recognized, though little is known about them. Northern Europeans are as a rule more phlegmatic and Southern

Europeans more volatile, but the amount of these differences and whether they are due to climatic influences, cultural development, or racial selection is not known.

2. NEAR ANCESTRY

Genealogical studies. Such racial and nationality differences of a biological nature as are found are, properly speaking, hereditary differences, though the term is usually applied to the influences of a less remote ancestry. Many efforts have been made to trace the characteristics of offspring to their parents and to determine the effect upon a child of parental endowments and limitations.

The pioneer in this work was Sir Francis Galton.[4] He made a list of eminent men, each one being on the average the most distinguished in a group of 4000. He found that the 977 men on his list had 535 relatives as eminent as themselves, while 977 men selected at random would have only four relatives of equal eminence.

English men of science studied by Galton, American men of science by Cattell,[5] and the superior children by Terman [6] were all found to come largely from the professional commercial and skilled labor groups. Since these are the ones who, as a rule, have the best homes and the educational advantages, it has been urged that the figures, while striking, do not show the influence of heredity alone. This was recognized by Galton, for he wrote: "There is no escape from the conclusion that nature prevails enormously over nurture when the differences of nurture do not exceed what is commonly to be found among persons of the same rank of society and in the same country"; or in other words that eminence is the result of "hereditary gifts plus education plus opportunity." [7]

The same conditions prevail with respect to the genealogical studies of certain families.[8] Some of these, like the Edwardses and the Adamses, contain an unusually large number of eminent people. Others, like the Jukeses and the Kallikaks, the Nams and the Hill Folk, have supplied the state with more than their share of feebleminded and degenerate children. The evidence again seems to be in favor of hereditary influence, but in these cases the environments have been different too — superior for the eminent, degraded for the degenerate. English Gypsy children living on canal boats who have had a poor environment and very little schooling measure low in intelligence, which may be due to their lack of schooling, to their poor heredity, or to both.

Twins. In all these studies, there have been two variables operating — the heredity and the environment. If one is to get at the truth of the matter, it is necessary to hold one of them constant and so follow the scientific principle of the *single variable.* But this has never been done.

The biological traits of children selected at random correlate around .00. It has been found that those of first cousins correlate about .25, though these are rarely brought up together. Pearson[9] has found that various physical and mental measurements of siblings (children of the same parents) correlate with each other around .50. In the case of twins, fraternal and identical, Thorndike[10] found the abilities on certain psychological tests to correlate higher than that, those nine to eleven years old averaging .83, those twelve to fourteen averaging .70. The fact that the older twins are less alike he interprets as being due to differing environments, and hence he concludes that their psychological similarities are due to hereditary factors.

Identical twins are more alike than ordinary *fraternal twins* since, according to the present theory, they develop from the

same ovum. Hence if identical twins can be found who have been brought up in different homes, their differences would be due to environmental conditions. Abilities of identical twins correlate around .90, and the average difference in I.Q. of fifty pairs reared together was found to be but 5.6. However, their environments are quite similar. As yet, only a few identical twins reared apart[11] have been studied, and some of these have been together a good deal. The average difference in I.Q. of ten of these pairs was found to be 8.6. Rather marked emotional and temperamental differences were found in some cases however.

Foster-home influence. If children are adopted into foster homes which are better than their own, and their intelligence improves, the environmental influence could properly be held responsible. Furthermore, if the correlation between the intelligence of siblings reared together is .50, and in separate foster homes is .25, again the environmental influence must be responsible. A study made under Terman's guidance concludes that the best home environment can raise the I.Q. about 20 points and the worst can lower it about 20 points, but such extreme conditions would not occur more than once or twice in a thousand. Seventy per cent of the children in America, whatever their home conditions, have an I.Q. within 6 to 9 points of their actual intelligence.

> Francis Galton, whose I.Q in childhood Professor Terman has estimated to have been close to 200, was reared in a home of exceptional cultural advantages, yet even without the possible 9 to 27 points contributed by his environment, he would still have ranked as a genius such as occurs in unselected populations only once in many thousands of individuals. Whether or not he would have succeeded in using his gifts with such telling effect if he had not had the training, education, and inspiring associates that were his, is of course another question. While many men and women have surmounted unbelievable

obstacles to achieve eminence, there is no telling how many others, of weaker stamina, have crumpled by the way....

Home environment in the most favorable circumstances may suffice to bring a child just under the borderline of dullness up over the threshold of normality, and to make a slightly superior child out of a normal one; but it cannot account for the enormous mental differences to be found among human beings.

If environment cannot account for men like Galton, who far and away outstrip the majority of their fellows coming even from such a favorable environment as theirs, still less can it account for an impressive number of eminent men whose early conditions of life have been of the kind that depress rather than enhance the I.Q.: men like Lincoln of the backwoods; Carlyle, whose simple peasant mother learned writing while he was at college so that she might correspond with him; Dickens, whose nursery was a London slum.[12]...

3. ENVIRONMENT

Nature and nurture. The influence of environment upon intelligence, school achievement, and social attitudes cannot be separated from that of heredity, since both together make up the conditions of development of the individual. One can compare the intelligence scores of children coming from a good environment with those coming from a poor environment, as has been done. But one cannot imagine an individual without any environment, or without any heredity.

Since the school has nothing to say about the heredity of the children who come to its doors, it must concern itself with the task of setting up those environmental conditions which are most conducive to individual growth and development.

Folkways. The customs of the groups from which the children come affect other phases of their school life than their scholastic achievement. Habits of speech and pronunciation, qualities of humor, play habits, and ideas about sportsman-

ship, etiquette, religious beliefs, parental discipline, and attitudes toward different members of the family — all these and many more illustrate the folkways [13] of differing social groups and economic levels, and the children absorb them as naturally as they eat and breathe. The location of the school in the city or its cost if privately supported, or its religious affiliation, may serve as a rough selective agency; but still within any one school the differences are wide indeed. They necessitate special kinds of school treatment just as much as differences in intelligence and temperament. But there are no general rules for dealing with them.

The differences in folkways are much more marked now than heretofore because of the rapid urbanization of recent years, which, together with the development of all means of communication, has brought the city into the country and has brought many former country dwellers into the confines of the city. The boy and girl from the farm tend to feel out of place in the city atmosphere and either become discouraged or, like the newly rich, try frantically to be like those about them. The country schools are either backward, or they tend to wean the pupils away from the land which in most cases is their proper heritage by borrowing some of the less satisfactory features which the city schools have adopted through necessity, instead of following their own proper development. Fortunately a number of consolidated schools have realized the advantages their location gives them over the crowded city, and have become centers of recreation and enlightenment in their communities.

Family constellation. Numerous studies have been made to try to determine the effect that position in the family has upon the child. So far as hereditary differences, physical size, health, and intelligence are concerned, it apparently makes little or no difference whether one is the first child or the

tenth. And so many other variables enter into the picture that in individual cases it is impossible to ascribe any excellence to position in the family.

There are a few conditions, however, which unless counteracted in some way or other, tend to produce behavior difficulties among children. An only child may be selfish and unsocial because he may be the center of interest at home. The same may be true of the youngest child, particularly if separated a few years from the next older sibling. Aunts or grandparents may complicate the situation, especially if they are "doting" or cantankerous, or if they work against each other or the parents to gain the affection of the child. The oldest child may have a sense of responsibility beyond his years if he has helped take care of younger brothers and sisters. Children from broken homes, that is, homes lacking one or both parents because of death or separation, may be more unstable emotionally and present more serious behavior problems than the average. But this may be due to the home atmosphere and, in the case of divorce, to the conflicts leading up to it, rather than to the actual absence of the parent from the home. Similarly, brutal or quarreling parents, or those who are overambitious for their children, may likewise create a home atmosphere which develops children who find difficulty in adapting themselves to the work and play groups in school. At any rate, such conditions as these are often found in the case of maladjusted children, though others may be found who come from equally bad homes who are not seriously troubled with behavior disorders.

Interests. While many interests[14] may grow out of the nature of the child, they are probably more completely determined by environment than is usually supposed. The Swiss are interested in skiing, and plainsmen in riding. Similarly, boys may be interested in gang depredations but just as much

attracted by sandlot baseball if there is a good place to play. While there are great differences in the tenacity with which children cling to what interests them, and similar wide differences in the value of the things they are interested in, it is a safe first step to provide healthy opportunities for the satisfaction of varied cravings.

So far as recreational interests are concerned, though they change from year to year, there is much overlapping. Hobby or sport, it makes little difference, if it provides a chance for each child to excel, and if an opportunity is given for group experience under healthy conditions and adequate though not too close supervision.

Educational interests tend to follow the intelligence, in part, and in part the well-liked teacher. The same is true of vocational interest, though the home and the occupations of the region perhaps exert a more dominant influence. The enlarged school curricula have done much to adapt courses to the differences in the interests of pupils with respect to education and recreation. But it is doubtful that, except in a few instances, they have given as much contact with the wide range of man's activities as they could. Pre-vocational and vocational courses are a splendid innovation, but more can be done with motion pictures, excursions, and actual work in fields, factories, and offices than has been done in the past.

Other interests follow various needs, while differing likes and dislikes do much to determine the success with which pupils fit into the school régime. When these should be respected, and when pupils should be helped to overcome them as foolish prejudices, it is hard to say. Good judgment and tact are needed here as elsewhere in school work.

4. SEX DIFFERENCES

Physique and growth. It would be interesting to speculate on what changes would take place in our civilization if women suddenly became superior to men in physical strength. It is probable that many of the former fallacious ideas about male superiority in other realms were due to this difference. Men average about four inches taller than women, and twenty pounds heavier, their legs are longer, and their bones and muscles are larger; but women use up relatively less energy. Men have larger brains than women (about 1400 grams to 1250) but not so large in relation to their body weight. The differences in size are no doubt due to the ductless glands, which account for many matters of temperament and emotionality. But so little is known concerning the direct influences of these glands that no certain conclusions can be drawn.

It is known, however, that girls mature more rapidly than boys so that at the age of thirteen they are actually taller and heavier than thirteen-year-old boys. This may be one reason for the homosexual recreational interests of children — boys tending to play by themselves, organize gangs, and develop their physical prowess. In harmony with this more rapid growth, girls are sexually mature at an earlier age than boys, the onset of puberty being at about thirteen and fourteen years respectively.

Intelligence and achievement. In the past, and in some cultures today, men have not allowed women to have the advantages of education and then have concluded that they were not so intelligent. Where equal educational opportunities have been provided, however, the women, on the average, have shown as much native ability as their brothers, and intelligence tests tell the same story. There is some evidence, however, that there is a greater variability in male intelligence,

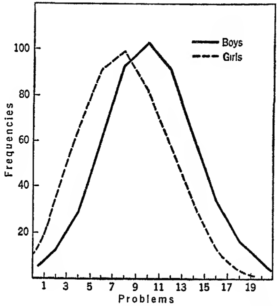

FIG. 25. DISTRIBUTION OF THE SCORES OF COLLEGE FRESHMEN ON A TEST OF ARITHMETICAL REASONING

Based on 514 girls and 716 boys, but the distribution for boys has been reduced to 514 cases by reducing ordinate values to 718 of the original. Both distributions have been smoothed (After Ellis.[15])

and that this wider scatter accounts for a greater number of male idiots and geniuses.

The old bogey, the difficulty of securing a random sampling, enters again here, however, as it does in the case of racial and nationality differences. About the only way to test large numbers of children is in the schools, and the further along children are in school, the more they become a selected group. If more boys have to drop out, to go to work or for other reasons, as is usually the case, the chances are that those who are left in school are a more highly selected group economi-

cally and perhaps educationally. Hence they might be expected to be a superior group, unless many of the superior also drop out.

In general, boys are slightly superior to girls in tests requiring reasoning (see Fig. 25). This is in harmony with the observation that there have been no great women philosophers or inventors and practically no great women scientists — professions which are certainly not dependent on brute strength. Furthermore, girls are, as a rule, superior to boys on tests requiring sensory-motor coordination and linguistic skill (see Fig. 26), which, again, is in harmony with the observa-

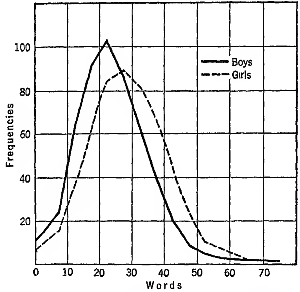

FIG. 26. DISTRIBUTION OF THE SCORES OF COLLEGE FRESHMEN ON A TEST OF ARTIFICIAL LANGUAGE

Based on 514 girls and 716 boys, but the distribution for the boys has been reduced to 514 cases by reducing ordinate values to .718 of the original. Both distributions have been smoothed. (After Ellis.[16])

tion that many clerical positions are held by women, and there have been a number of great women writers. Such differences in scholastic abilities as may be found may be due to differences in innate ability, or they may be due in part to the amount of time devoted to scholastic work. This, in turn, depends on the amount of time boys are able to give it or are willing to give it, which brings into account other than purely intellectual considerations.

Emotion and temperament. In spite of the fact that psychological sex differences which have thus far been measured are relatively slight, the sexes are nevertheless so different in fundamental characteristics of personality that the pugnacious, self-assertive masculine type and the submissive feminine type have been basic to most characterological classifications.[17]

Masculine characteristics are discernible in the personality make-up of both men and women, and the same is true of feminine characteristics. Seemingly different classes of occupations attract those leaning in one direction or the other, though the stereotype and the elusiveness of criteria make exact delineation difficult.

To the extent that real personality differences exist between the sexes, they are no doubt due to two conditions — to the effect of the internal secretion of the sex glands, and to the differing social environment in which boys and girls are brought up. The latter condition is probably more potent than is supposed. The family and other social groups expect and demand certain kinds of behavior of boys, and quite different kinds of girls. When Tommy falls down, he is told that big boys don't cry; but when his sister Sue falls down, she is apt to be told to come to mamma and get the bump kissed. Indeed, it has been urged[18] that the masculine characteristics are those of a dominant race or group, while the feminine char-

acteristics are those of a repressed group. In certain matriarchial tribes where the women rule, many of the personality characteristics and courtship practices of the sexes are reversed.

In conclusion, it may be said that intellectual differences between boys and girls in school if they exist at all are negligible. If there is any superiority in favor of the girls it may be attributed to their earlier maturation and to the process of selection. It may be that the schools as they are, and especially the women teachers in the schools, make more of an appeal to girls than they do to boys.

5. SCHOOL ACHIEVEMENT

Grade placement. One of the major contributions of psychological measurement has been the information it has provided concerning the abilities of children in different grades. Progress from one grade to another supposedly implies an increment in ability, and it is true that the central tendencies of the scores of children on school achievement tests are higher the farther along the children are in school. But there is a wide variability.

While it has long been known that some of the children in any grade do their work better than others, it has taken the tests to show how much difference there is. Some children in the eighth grade (Fig. 27) are well below the central tendency of the sixth, while some in the sixth grade are above the average in the eighth.

These differences are due in large measure to differences in intelligence, but various special disabilities, lack of interest or training, and other factors are in part responsible. Both biological and social factors thus operate to produce wide individual differences, with the result that many kinds of children are found together in any one grade. This is shown even more

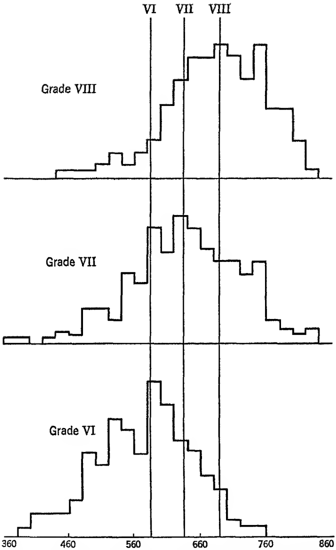

FIG. 27. OVERLAPPING IN SCHOOL ATTAINMENTS, COMPOSITE SCORES, FOR THE SIXTH, SEVENTH, AND EIGHTH GRADES [19]

strikingly, perhaps, in Fig. 28. The curves represent the distribution of the achievement scores of the same group of 33 pupils at the close of their fourth, fifth and sixth grades. It is to be noted that more than half of these pupils at the close of the sixth grade are still below the performance of the brightest when they were all in the fourth grade.

The meaning of a grade as a homogeneous group ready for the same kind of instruction in the same materials has completely vanished, and the norm for achievement becomes an arbitrary point, a median on an achievement test.

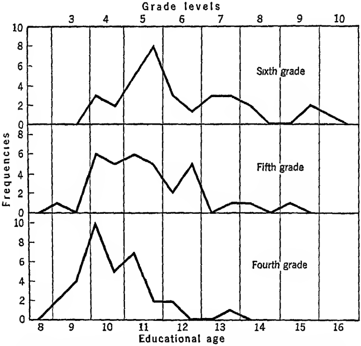

FIG. 28. DISTRIBUTION OF EDUCATIONAL AGES OF A GROUP OF 33 PUPILS AT THE CLOSE OF THEIR FOURTH, FIFTH, AND SIXTH GRADES [20]

Efforts to obtain more homogeneous groups within grades on the basis of intelligence scores help somewhat, but many educators are coming to consider the grade as a chronological distinction only, a social group of children of approximately the same age, the members of which do the work which is at their individual level of accomplishment. This does away with the motivation involved in working to pass to the next grade, which has certain advantages, and certain disadvantages as well. It necessitates considerable individualized instruction, methods and materials for which are rapidly being developed. And it brings about the substitution of achievement scores for teachers' marks.

Special talents. If special handicaps and disabilities require individual attention, so, too, do special talents. If the grade system, by providing individualized instruction, escapes the educational lockstep, the way is open for gifted children to shoot ahead at their own natural rate, whether it be in reading more books, working with figures, or developing in the arts.

Many of the schools of the past, and of the present, too, have much to answer for in their forcing of eager minds into humdrum tasks, so extinguishing every spark of enthusiasm they may have had. It was the dry-as-dust schoolmasters who rated some of those children stupid who, after they escaped from the atmosphere of pedantry, penned the lines or the music that have made them immortal.

Socio-economic status. Besides the physical and mental differences in children of the same age and grade, there are socio-economic differences which are likewise of importance in dealing with them in school. The economic background of children of the same intelligence is an important factor in determining the amount and nature of the schooling they receive.[21] It forces some out of school at an early age and

permits others to continue with their needed training. Of those who remain in school, differing vocational interests help to determine curricular offerings.

Children's language habits are copied from the groups from which they come. Some of them, dating back to what was good English in an earlier day, are now at odds with the rules of the grammarians and cause untold trouble for English teachers. An example is *eat* (pronounced *et*) for *ate*, once quite correct, but now unacceptable.

The amount of cultural opportunity afforded by a home may bear no relation to its economic status. From all levels save those of the destitute come some children who have known the value and joy to be found in books, who have been stimulated to intellectual endeavor, and who have the ambition to make something of themselves. And from all levels come other children who have never read a book of their own accord and have never known anyone who has, and whose capacity for development seems to be nil.

In general, however, these are the exceptions. A quantitative scale[22] of socio-economic status based on a record of the educational and vocational grouping of the parents and their possession or non-possession of certain household objects, has been found to correlate positively with a number of other variables, including scholarship and school honesty. Which are the causal factors and which the resultant ones, it is difficult to say.

Summary. Differences between racial groups (and nationality groups also) are largely cultural rather than biological, though slight intelligence differences are consistently found. The older genealogical technique followed by studies of siblings, twins, and foster-home influence have shown the comparatively slight effect of environmental conditions within the present culture in determining the I.Q. Socio-economic

status, schooling, age, sex, and the prevailing culture affect avocational and vocational interests and activities.

Sex differences are greatest in the emotional and temperamental sphere and are qualitative rather than quantitative in the intellectual.

School adaptations to the wide individual differences are many, including grading, grouping, individualization of instruction, curricular elections, and pre-vocational and vocational training.

QUESTIONS

1. What are some of the psychological findings important for education which come from a study (*a*) of the nature of man? (*b*) of difference between individuals?
2. Suggest some characteristics of people that are biological in nature; some which are traceable to social heritage and tradition.
3. Why must the general findings in regard to racial and nationality differences in intelligence be interpreted cautiously?
4. Report the details of one of the genealogical studies of hereditary influence (see reference 19, Freeman, pp. 78–79), giving conclusions and criticisms.
5. What were the contributions of Pearson, Galton, Cattell, and Terman to the nature-nurture problem?
6. What do the findings in regard to overlapping of pupil achievement in successive grades suggest in regard to the grade placement of pupils?
7. In what ways are children from a poor socio-economic background handicapped educationally? Does the situation conflict with the democratic principle of equal opportunity for all?
8. Describe some family situation which you think may be responsible for the difficulties some child you know has in making adjustments.

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CHAPTER VIII

SENSATION

The senses. A child would not be expected to approach a toy lying on the floor if he could not see it, nor show fear reactions when an iron bar is struck if he could not hear it. Nor could he take intelligence tests if he could neither see nor hear the test questions. Indeed, the senses are the means of furnishing such familiar experiences to everyone that they are quite taken for granted unless by some illness or accident one is deprived of their use. Blindness or deafness shuts off a part of the world from the one so afflicted, and occasionally the partial loss of the smell or taste sense, as with a hard cold, or a temporary numbness reveals a further dependence on them. In fact if there were no senses, it might be said that the world would cease to exist, as it does for a person who is under the influence of an anesthetic.

The investigation of the sense organs reveals their amazingly complex structure, though the way they operate to produce conscious sensory experience is still shrouded in mystery. While many suppose man has but five senses, there are in reality more than five; and all function so harmoniously that only in rare cases is there any confusion.

1. PROPRIOCEPTORS

The kinesthetic sense. The first senses to be considered are a group known as the proprioceptors, which report movements within the organism. They include the kinesthetic and the static sense, neither of which is listed among the usual five. The kinesthetic sense reports movements of the

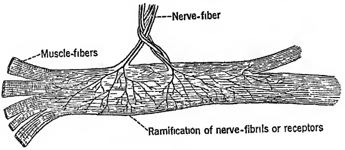

FIG. 29. KINESTHETIC RECEPTORS
(Sensory ending in striped muscle.)

muscles, tendons, and joints. Nerve endings (see Fig. 29) which lie in these parts are sensitive to being pulled and pushed about with joint movement and muscle contraction, with the result that sensations of strain, weight, and bodily position are obtained.

Kinesthetic sensations make possible precise coordinations. For example, if one shuts his eyes, he can touch his index fingers together, hold his hands a foot apart, or extend his arm in the same position in which the other is being held, about as accurately as he can with his eyes open. Differences in the weight of objects can be distinguished with surprising exactitude. Indeed, long series of experiments[1] have been performed to determine how slight a difference in weights can be discriminated and what the "just noticeable difference" (j.n.d.) is. It has been found that the heavier the weights, the greater the difference between them must be to be noticed. That is, if one can just barely discriminate between two small weights, the difference between two larger weights has to be greater in order to be discriminated. Thus the j.n.d. is always a definite fraction of the weight lifted and not a constant or absolute value.[2]

Kinesthetic sensations provide the basis of judgment in many practical situations; for example, in judgments of the consistency of batter being stirred or ice cream being frozen, or the hardness of wood in cutting, or the toughness of steak. They are used quite involuntarily in many habitual acts such as walking, hammering, or playing tennis. If the pavement is a little uneven or if the hammer or racket is heavier or lighter than the accustomed one, the fact is noticed at once.

Here more than anywhere else the doctrine of the necessity of learning by doing is incontestable. Sensori-motor skills, which are to be discussed later, depend for their control on kinesthesis; and it is absolutely necessary to "get the feel of the thing," whether the thing is a hammer, a tennis racket, or a violin, in order to develop any skill in its manipulation.

The static sense. The sense of balance, as the static or vestibular sense is often called, works with the kinesthetic in maintaining posture. Fine nerve endings in a part of the inner ear, called the semicircular canals, form the receptors. (See Fig. 30.) These "canals" are tiny tubes of bone and membrane arranged in three planes, and in man are scarcely half an inch across. The membranous labyrinths (canals) contain a liquid into which tiny hair-like cells project. Changes in the position of the head produce movement in this liquid and the tiny bonelike particles in it, and these press against the hair cells which are connected with the fibers from a branch of the auditory nerve, thus producing static stimulation.

Seasickness results from the unwonted disturbance of this liquid, and the same effect may be produced experimentally by placing a blindfolded subject in a slowly revolving chair or on a revolving table. As long as he remains quiet, and the

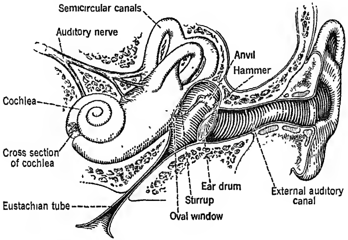

FIG. 30. THE EAR IN CROSS SECTION: SEMICIRCULAR CANALS

speed of revolution is increased or decreased gradually, there are no ill effects, though decreasing speed gives the illusion that he has begun to revolve in the other direction. But if he moves his head to one side, he becomes nauseated.

An interesting demonstration of the importance of the semicircular canals shows the effect produced when their action is interfered with. If a small amount of ice-cold water is dropped into the ear, the movement of the liquid that is in the canals is temporarily interfered with because of the effect of the temperature of the water. The result is a series of involuntary turning movements of the eyes or head back and forth known as nystagmus.

The utilitarian value of static sensations is unquestioned, in the control which, in cooperation with the kinesthesis, they make possible over posture and balance, and over the force exerted by the body. There is, too, a certain joy in well coordinated rhythmical movement which finds expression in

swings and roller coasters, and also in skating, skiing, and dancing.

2. INTEROCEPTORS

The organic sense. Interoceptors are the sensory receptors which are stimulated by contacts with the inner surfaces of the body. The organic, olfactory, and gustatory senses belong in this category. The organic senses report contacts or changes in the *viscera* or internal organs of the body. Chief among these are sensations arising from the alimentary tract such as thirst, hunger, "stomachache," and nausea. Then there are those of the respiratory tract, often compounded with others, such as the sensations of coughing, sneezing, and difficult breathing. Other systems, as for example, the circulatory and the sexual, likewise furnish their quota of organic sensations.

The usual answers to the question, "How are you today?" or "How do you feel now?" are incomplete reports of the sometimes diffuse and sometimes localized organic sensations, as are the more detailed literary descriptions of men in war and women in love, to mention only two examples. Some painful organic sensations are indicative of diseased conditions like appendicitis or bronchitis, a sore throat may presage diphtheria, and the traditionally neglected "growing pains" are certain indicators of some focal infection, perhaps of the teeth or tonsils.

The olfactory sense. The receptor for the sense of smell, or the olfactory sense, is a mass of tiny nerve fibers like the frayed end of a piece of string, back of the upper part of the nose (Fig. 31). Since it is stimulated by minute chemical particles of matter afloat in the air, olfaction has been termed a chemical sense. It is apparently keener in dogs and some other

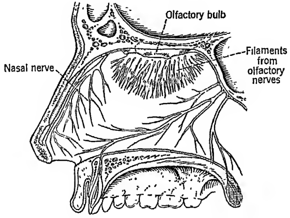

FIG. 31. THE OLFACTORY RECEPTOR

animals than it is in man, though it is not found so low in the animal scale as are the other senses which have been discussed thus far. One may become quite insensitive to odors which at first are very noticeable through the process of *adaptation*. Those who have been sitting in a stuffy, badly ventilated room may be surprised when some one comes in from outside and hastily opens the windows.

Various efforts have been made to analyze the different kinds of odors and classify them into some sort of system. None of these is very successful, so complex are the different combinations to which man is sensitive. According to the most widely accepted classification[3] the elementary odors are arranged at the points of a prism leaving intermediate connecting surfaces and lines for fusions or blends (Fig. 32).

Fine olfactory discriminations have no great utilitarian value, though unpleasant odors are often a warning sign of the presence of noxious matter in food or in the air. Here, however, nature is ironic, for a smoky atmosphere though unpleas-

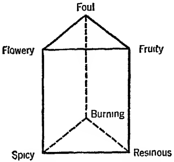

FIG. 32. OLFACTORY PRISM

The six basic odors are at the six points of the prism and are as follows Flowery or fragrant: violet, heliotrope. Fruity· lemon, citronella Foul or putrid: hydrogen sulphide, decaying organic matter. Spicy. nutmeg, cloves Resinous. turpentine, cedar Burning tar, smoke

Some of the mixtures along the edges or across the planes of the pyramid are as follows Flowery-fruity: geranium, vanilla Fruity-foul. dill, onion Spicy-burning. browning coffee Burning-resinous burning varnish. Fruity-resinous· pine, camphor. Spicy-foul garlic Fruity-spicy. mints Arborvitae is believed by Henning to be located where the flowery-resinous and fruity-spicy lines cross (After Henning.[3])

ant is relatively harmless, while mineral dust, which is no more unpleasant, results in silicosis or "grinders' consumption" which in time is fatal. And carbon monoxide, which is quite odorless, is a deadly poison.

It has been suggested that odors call up vivid remembrances of past experiences, and there is some evidence of a close relationship to sex excitement, particularly in the lower animals. It may be that artificial perfumes have a similar effect. At any rate the aroma of food, the bouquet of fine wines, and the fragrance of flowers have long enriched the esthetic experience of man, though they are too elusive to take the form of an art.

The gustatory sense. Taste or gustation is another chemical sense. Tiny visible nubs or papillae on the surface of the tongue and to a much lesser extent in other portions of the mouth cavity contain taste buds in which hair cells connect

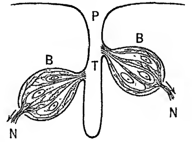

FIG 33. GUSTATORY RECEPTORS

P, pit in papilla on surface of tongue, *T*, taste pore and hair cells, *B*, taste buds, *N*, nerve fibers entering taste bud.

with the ends of a sensory nerve. A chemical substance in the mouth must be soluble in order to affect the ends of the hair cells and so be tasted (see Fig. 33).

Exploration of the gustatory sense is conducted by placing substances of different flavors on very small areas of the tongue and blocking the nasal passages so as to shut off olfaction. This reveals the surprising fact that only four tastes can be distinguished — sweet, sour, bitter, and salt. Furthermore the tongue is more sensitive to sweet stimulation toward the tip, to bitter at the back, and to sour along the sides; but to salt it is equally sensitive over its whole surface.

It may seem scarcely credible that the endless number of table delicacies can be no more than combinations of these four elemental taste qualities. As a matter of fact, more enters into palatability than taste, as may readily be understood by thinking of the difference between hot and lukewarm soup, cold and warm lemonade, or dry and moist crackers; yet the actual taste in each case would supposedly be the same.

Not only do temperature and texture enter in, but the smell of food also is of great importance, as anyone can tell who has

had a cold which has stopped up his nasal passages. All of these sensations combine into a sensory *fusion*, which is not often analyzed into its separate parts.

3. EXTEROCEPTORS

The sense of touch. The exteroceptors are the receiving organs which are stimulated by objects outside the body that in some way come into contact with its outer surfaces. The most primitive of these, one of the few to be found in single-celled organisms, is irritability or the capacity to react to contact (see Fig. 34).

Though the skin contains the touch receptors, sensitivity is not spread evenly over its surface. If a small area of the skin is marked off, and every point on it is touched systematically with the end of a horsehair, it will be found that a number of such contacts will produce no sensation whatever.

Another way in which the different body surface areas differ is demonstrated by the esthesiometer, a little instrument like a drawing compass with points slightly blunted. If the two points are brought down gently but simultaneously on the back of the hand, they must be spread to an average of 30 mm. to be felt as two points; whereas they are recognized as two points on the finger tips at about 2 mm., and on the tip of the tongue at 1 mm., while on the back they must on the average be 54 mm. apart to be discriminated.

The fact that one feels contact at separate points on the skin suggests that there are tiny sense organs at these points, which seems to be the case; but there are different kinds of skin sensations and different kinds of receptors. One of these is the nerve endings at the roots of the hairs, which are very sensitive to the slightest touch — even of a single hair — and are of assistance in the control of movements in the case of

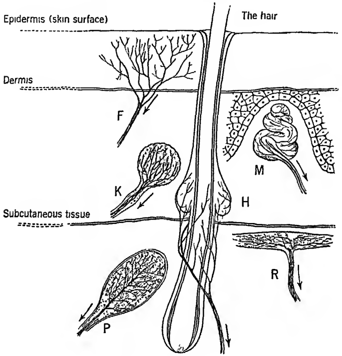

Fig. 34. Cutaneous End Organs or Receptors

F, free nerve ending — pain (?), *M*, Meissner corpuscle — pressure; *K*, Krause bulb — cold (?), *H*, hair nerve — touch; *R*, Ruffini cylinder — warmth (?), *P*, Pacinian corpuscle — deep pressure (There is still some doubt about the function of these organs, particularly those with a question mark.)

the vibrissae or whiskers of cats, rats, and many other animals.

The pressure sense. Still other tiny end organs in the deeper surface layers report pressures that are more forceful than light surface contacts. This may be demonstrated by touching the skin lightly with the end of a pencil and then bearing down scmewhat. Quite a different quality of sensation is felt. The pressure and contact senses combine with

movement and kinesthesis to furnish sensations of rough and smooth.

The thermal sense. Many people probably do not think of the ability to sense temperature as different from the sense of touch. Not only is it separate, but the sensations of hot and cold are distinct from each other. This may be demonstrated by the "punctiform" method as follows.

If in a circumscribed area on the skin surface (say an inch square), every point is touched with the end of a warm wire, and each spot marked with an ink dot where the sensation of warmth is felt, it will be found that at only a relatively small number of points will anything be felt but the contact. Then if the same thing is done with a cold wire (the wire may be heated in hot water and cooled in ice water) the points where cold is felt will be slightly more frequent than the warm spots, and will not coincide with them. It should perhaps be added that the temperature organs in the skin are stimulated not only by heat and cold, but also by such substances as mustard, pepper, alcohol, and menthol.

The principle of *adaptation*, before referred to in connection with olfaction, can be illustrated quite strikingly with the thermal or temperature sense. If three bowls of water are prepared, one quite warm, one tepid, and one cold, and if one hand is placed in the warm and the other in the cold water for two or three minutes, practically all sense of how warm and how cold they are will disappear. Then if both hands are placed in the bowl of tepid water, the illusion will be created of two temperatures: it will seem warm to the hand that has been in the cold water and cold to the hand that has been in the warm water.

Like the organic sense, the temperature sense is a direct indicator of bodily needs. As the hunger pangs express the need for food, those of temperature inform the individual of

his need for clothing and shelter. Without these he would be in constant danger of starvation, or of exposure to cold or to the sun.

The pain sense. Punctiform exploration of a skin area with a needle point shows the same kind of scatter for the pain receptors as was found in the case of the other cutaneous senses, contact and temperature. At some points a sharp tingling sensation is felt at the slightest touch, while at others the needle can be pushed in an appreciable distance with no discomfort. The pain spots are found to be more frequent than the others. The receptors for pain, supposedly free nerve endings in the skin, are stimulated not only by pricks, but also by intense heat and cold, by electricity, and by certain chemicals. However, intense stimuli (for example, very loud noise and very intense light) acting on any sensory receptor, produce pain sensations.

For the most part pain stimuli are harmful, but not always; and sometimes the conditions which cause pain are distinctly beneficial in the long run. The situation produces ethical problems for man, who must learn what to do in the case of discomfort, and who must at times choose and endure temporary suffering to obtain later satisfaction for himself or for someone else.

The visual and auditory senses. Seeing and hearing are so important for the higher animals and man, and the learning process is so dependent on them, that they require special consideration. The eye and the ear are often referred to as *distance receptors*, since they are stimulated by light and sound waves, respectively, coming from a more distant source.

4. THE AUDITORY SENSE

The hearing receptors. The receiving organs considered thus far are relatively simple. The ear, however, is a more complicated mechanism, and like many such, the visible portions give no idea of its operation (see Figs. 30 and 35). The *outer ear* of man is of little value in the localization of sounds since it has lost its versatility of movement.

The *middle ear* is a physical instrument. The ear drum or *tympanum* is at the end of the inch-long auditory canal, and is a tough membrane which vibrates with the sound waves as one can sometimes feel a wooden chair or door vibrate to the sound of an organ. Attached to it on the inside are the ear bones, roughly resembling a hammer, an anvil, and a stirrup, and having the Latin names for these objects. They vibrate with the tympanum and transfer this vibration to the opposite wall of the middle ear. It is this middle ear which sometimes becomes congested in colds if the Eustachian tube leading from it to the throat is filled up, in which case punctur-

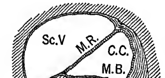

FIG. 35. CROSS SECTION OF THE COCHLEAR CANALS

This is cross section of cochlea in Fig. 30, enlarged *OC*, organ of Corti; *CC*, cochlear duct; *AN*, auditory nerve; *MB*, basilar membrane, *ScT*, scala tympani; *ScV*, scala vestibuli; *MR*, Reissner's membrane.

ing the tympanum (it heals up again) is sometimes resorted to so as to relieve the congestion.

The *inner ear* is the most complicated of all. A liquid in it is set vibrating by the ear bones, and this vibration is transferred to the auditory receptor itself, the *cochlea*, which is joined to the semicircular canals of the static sense. The cochlea looks a little like a snail shell, a tiny spiral tube divided in two throughout its length by the *basilar membrane*, along which runs the *organ of Corti*. In this organ, the vibrations of the cochlear liquid act on the true auditory receptor cells and thus upon the nerve endings of the auditory nerve. There are several theories seeking to explain how the different tones are differentiated, but no one of them is completely satisfactory.

Hearing defects. Out of every hundred school children five have hearing defects, some of them so marked as to be a real handicap.[4] Deafness in children constitutes a real problem, in dealing with which the school must assume some degree of responsibility.

Rough tests of hearing can be made very simply by the use of a watch, or better, by an audiometer, an instrument which will produce sounds of various intensities. The distance away that the sound can be heard by the majority of a group of children can be discovered by trial; those who cannot hear it at this distance probably have defects which should receive medical attention. If this is not forthcoming, or if it is powerless to effect a cure, every effort should be made to enable the child to hear what is going on by placing him near those who are doing the talking. Often children do not realize that their hearing is defective because they have nothing to compare it with and hence suppose that spoken words are always indistinct.

Quite a different problem presents itself in the case of

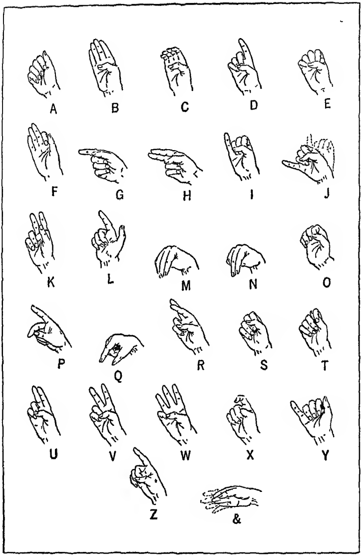

FIG. 36. THE MANUAL ALPHABET

totally deaf children. These are given special instruction in the regular schools of the larger cities and in private institutions. The manual alphabet (see Fig. 36), a series of hand signs worked out in the seventeenth century, was a great step in advance in the care of the deaf; and when thought of as growing out of expressive movements and sign language, it is seen to be really no more artificial than the spoken word.

But among people who hear, the manual alphabet shuts the deaf off into a world in which they can converse only with themselves. The art of lip-reading, however, enables them to mingle and converse with others. And it can be learned fairly readily by those who could formerly hear because they know the sounds of the words which are being formed by the mouth and throat of another. But the congenitally deaf, those who have never heard the sound of a human voice, are therefore mute. For them the task is much greater, for they must also be taught to speak. Their sensory control is not the sound of the words, which they cannot hear, but the movements of the lips, throat, and tongue, which they must observe and try to imitate.

Tonal discrimination. Sounds are made by vibrations in the air. If these vibrations are all uneven, what is heard is called noise; if they are evenly spaced it is a tone, though a pure tone requires a special apparatus to produce it. Tones vary among themselves. The size or amplitude of the vibration is responsible for loudness or *intensity*, and the overtones for tonal quality or *timbre*, which distinguishes the notes of different musical instruments. Overtones are really additional tones of different pitch and intensity sounding at the same time, and are produced on a piano, for instance, by the string vibrating in part and as a whole at the same time (or by the sympathetic vibration of other strings).

The rapidity of the vibrations is what determines the *pitch*

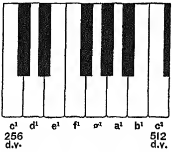

FIG. 37. PIANO KEYBOARD: ONE OCTAVE

of a tone. This is measured in terms of the number of complete vibrations per second, called cycles[5] and written $\sim$ or d.v. (double vibrations). The keyboard of a grand piano (see Fig. 37) from its lowest note, a_2 (27.5 $\sim$) to its highest, c^5 (4224 $\sim$), includes only a part of the total range of audible tones, which is from about 12 to 50,000 $\sim$, between which a person with a keen sense of pitch can discriminate about 11,000 different tones. Middle C (c^1) is the tone produced by a frequency of 256 $\sim$; the tone an octave higher (c^2) has a frequency of 512 $\sim$, or twice as many, and so on.

Musical talent. One who has a good ear can distinguish differences as small as one vibration or so in the middle octave, but there are wide individual differences. Many children seem to have very little sense of pitch, and sing in what is very nearly monotone. C. E. Seashore has held that such abilities, or the lack of them, are inborn, like differences in intelligence, that improvement takes place with growth, but that instruction cannot increase an individual's ability beyond his relative position. If he is in the lowest 25 per cent when he is in the sixth grade, he will still be in the lowest 25 per cent when he is in college, and he should therefore be discouraged from taking up musical work. However, recent

experiments seem to show that considerable improvement in pitch discrimination may be made with training.

The Seashore Tests of Musical Talent[6] test what are supposed to be native auditory capacities for discrimination. Since they are available on phonograph records, they are relatively simple to administer. Rigid training may improve these scores and hence the abilities they measure, but probably to a limited extent. In addition to sense of pitch there are tests for sense of time, sense of rhythm, intensity, consonance, and tonal memory. Other tests[7] have been devised, some of which aim to measure musical abilities which are acquired, such as signatures, note reading, and so on. Musical talent is more complex, however, than the elements which have been measured; the forms which tone and rhythm may take are infinite, and among the fine arts music is perhaps the most universal in appeal.

5. THE VISUAL SENSE

The eye. With the development of printing, the importance of the eyes, as well as the strain placed upon them, increased many fold. Even before this added burden, visual judgments of size, distance, and position were most effective and hence served as a means of constant adjustment. Now, with the dependence on reading, they also serve as the chief avenue for the development of mental life.

The eye is very much like a camera (see Fig. 38), but with important differences due to the fact that the eye is made of living substance. In this description the parts of the eye corresponding to the parts of a camera are in parentheses. Both are light-proof boxes with a lens (lens) in front, which focuses the light rays on a sensitive film (retina) at the back. Both are lined with a black wall covering (choroid

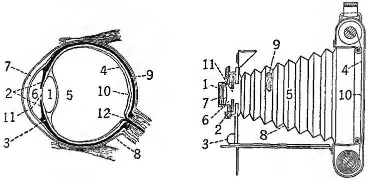

FIG. 38. THE EYE AND A CAMERA

1, crystalline lens — lens; 2, iris — diaphragm, 3, ciliary muscle — focusing screw; 4, retina — film, 5, vitreous humor — dark chamber, 6, aqueous humor — space between diaphragm and lens; 7, cornea — filter, 8, sclerotic coat — bellows; 9, choroid coat — black linings, 10, fovea — point of focus; 11, pupil — opening, 12, blind spot.

coat) inside a tough outer structure (sclerotic coat). One is filled with air, the other with a transparent liquid (aqueous humor in front of the lens and vitreous humor in the main part of the eye). The diaphragm (iris), by enlarging and contracting, controls the amount of light admitted. The shutter (lid) regulates the length of the exposure. Six muscles turn each eye and control its movement in the socket.

There is a transparent protective covering, the cornea, in front of the lens of the eye which might correspond to a light filter. An important difference between the eye and a camera is the focusing apparatus. In the camera the rays of light are brought to a focus on the film, instead of in front or back of it, by increasing or decreasing the distance between the rigid lens and the film, just as one can bring the sun's rays to a point with a magnifying glass by moving it up or down. In the eye, however, this focusing is done by the lens itself, which bulges or gets thinner by the action of the circular ciliary muscle,

The greatest difference of all is in the nature of the chemical, sensitized film, the retina. Optical instruments made of steel and glass are more flawless than the eye; but they cannot see. The retina covers the back half of the inner surface of the eye, and contains numberless special nerve cells called rods and cones, from their shape. The chemical emulsion of the retina, the visual purple, in response to light, stimulates these cells, and the nerve current travels from them over tiny fibers to the optic nerve and over it to the visual area in the back part of the brain. The point in the retina where the optic nerve attaches is called the blind spot, because a small area focused on it cannot be seen (Fig 39).

Visual defects With such a complicated mechanism, it is to be expected that there would be defects,[8] there are so many parts to get out of order. Failure of the eye muscles to function properly results in a person's being cross-eyed or wall-eyed, what is technically known as *strabismus*. The commonest defect is *astigmatism*, a distortion of the retinal image due to irregularities in the cornea or the lens. Another common defect is *myopia* or near-sightedness, due to a lengthened eyeball, causing the light rays to focus in front of the retina and so blurring the image. And there is its counterpart, *hyperopia* or far-sightedness, due to a shortened eyeball, which results in a similar blurring because the rays come to a focus behind the retina. The latter condition overworks the ciliary muscle in bringing about accommodation, and so produces eye strain with its accompanying symptoms and disorders; but both can

FIG. 39. THE BLIND SPOT

Hold the page about ten inches from the eyes, focus on the cross and close the right eye

be helped or corrected with glasses. More serious conditions are due to diseases of the eye or growths like cataract, which shut off the light rays or injure the retina and cause partial or total blindness.

Naturally, any visual defects are a real handicap for children, and should not go undetected Often the distance at which children hold a book from the eyes indicates a visual defect; but simple tests with the usual optical charts should be given to all school children as a matter of routine, and those found defective referred through their parents to an oculist.

Many a child has ceased to have scholastic difficulties after getting glasses. And often the strain to which children subject their eyes, even though they succeed in doing the reading that is required of them, seriously affects their health and temper. The condition helps make children into what are called "school problems"; but they are not cured at once merely by donning their spectacles, for the habits they have formed take longer to correct.

More serious cases of visual handicap require special "sight-saving classes." In these, much of the work is oral, books are printed in very large type, and the children learn to use the touch system on the typewriter. In the case of blindness, *Braille* is taught. This is a system of raised symbols, in which many books have been published, these can be read by touching the raised surfaces with the tips of the fingers.

Peculiarities of vision. The cones are the organs which respond to color and are found in greatest abundance in the center of the retina, particularly in the *fovea*, the point of clearest vision just opposite the lens. If it were not for the cones, objects would appear as they do in an ordinary photograph, merely varying patterns of gray between white and black. Indeed a colored object does look gray if it is held a little distance to the side when the eyes are looking straight

ahead. This brings the object to a focus near the edge of the retina where there are practically no cones, only rods. Another interesting phenomenon of this sort is the colorlessness of *twilight vision.* Flowers at dusk appear only in different shades of gray, for the cones do not function in twilight.

Approximately four out of every hundred men and a tenth as many women are color-blind, and practically all these are thus defective only for red and green. Both colors apparently look to them much the way gray or a dull olive drab looks to those of normal vision. This is brought out by tests [9] of *color-blindness* which were developed for locomotive engineers, who must be able to distinguish red and green signals. It is unfortunate that traffic stop lights use these same colors, for color-blind drivers cannot distinguish them and therefore have to depend on other cues, such as a knowledge of which color is above and which below.

Red and green are said to be *complementary* colors, as are blue and yellow. If a green disk is placed against a neutral gray background and looked at fixedly for a half a minute or so, when it is quickly taken away a dull red color will seem to have taken its place, though it will move around or perhaps disappear with the movement of the eyes. This is the *negative after-image*, and it can be seen, though it appears very much smaller, if the eyes are closed. The negative after-image of every color is its complement; in this respect, black and white are complementary. The relationship of the complementary colors to each other has been schematically presented in the form of a double pyramid (see Fig. 40).

Colors can be mixed by means of a whirling device known as a *color wheel*, which causes light of two or more kinds (colors) to fall on the retina in rapid succession. When complementary colors are placed on a disk and revolved smoothly at a high rate of speed, instead of a mixture which occurs in the case of

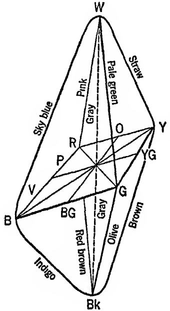

FIG. 40. THE COLOR PYRAMID

This figure represents schematically the relation between light wave and colors. The line *Bk-W* (black-white) indicates changes in intensity of stimulus from zero to maximum. The central square shows the colors of the spectrum. *B*, blue; *V*, violet; *P*, purple, *R*, red, *O*, orange; *Y*, yellow; *YG*, yellow-green, *G*, green; and *BG*, blue-green. Colors of intermediate brightness or gray value appear on the connecting lines

other colors, the result is a neutral gray of the brightness value of the colors themselves.

When complementary colors are placed next to each other as in a painting or a costume, each by *contrast* seems to intensify the color of the other. Since we have two eyes which point in the same direction, in contrast with the eyes of birds and fish, certain other phenomena of vision appear. One of these is *binocular rivalry*. If one looks at two disks of different colors, one with each eye by means of lenses, like the old-fashioned stereoscope, the colors may fuse, or they may appear alternately. In most people one eye is *dominant*, doing most of the work; but when a person has a defect in one eye he tends to favor it, so putting a continuous extra strain upon the good eye. There is a definite need for glasses under these conditions before the good eye, too, becomes defective.

6. CHARACTERISTICS OF SENSATION

Quality. The characteristic feature of a sensation is its quality, which is determined by the receptor that reports

it. Any stimulus which can act upon a receptor is reported in just one way by that receptor, though it may be sensed in other ways by other receptors. Not only light, but pressure on the eyes and an electric current will stimulate the retina, but all are reported as light. This illustrates what is called the doctrine of "specificity of function." A magnetic field, on the other hand, stimulates no receptor, and hence has no sensory quality; its presence can be detected only by its effect on other things.

As has been said, tonal qualities which are heard as variations of pitch are produced by vibrations differing in rate. Different visual qualities, which are seen as the colors of the rainbow or spectrum, are likewise produced by vibrations of differing rapidity. The range from the extreme edge of the red to the far edge of the violet is from 400 to 800 trillion vibrations per second. The length of these waves varies from 780 mμ.* red, to 400 mμ. violet. Light of wave lengths just longer than red, called infra-red, is invisible, can be measured in heat units, and will affect a photographic plate, as will light with rays just shorter than violet, called ultra-violet, which is also invisible, though its rays produce sunburn on the skin. Still shorter are the invisible X-rays and Gamma rays, which are estimated to be as short as .020 mμ. What quality these would have if we could see them, or the gigantic wave lengths of wireless telegraphy which range from 400 to 25,000 meters, no one can say.

Intensity. All sensations can be placed somewhere along a scale from those so slight as hardly to be perceived to those so intense as to produce actual pain. Intensities of sound and of light are produced by the width or amplitude of the vibrations concerned: the greater the amplitude, the greater the

* One μ (Greek letter *mu*, for micron) = a thousandth of a millimeter; one mμ (millimicron) = a thousandth of a micron, or a millionth of a millimeter.

intensity. Greater intensities tend to attract attention, and extreme intensities to destroy the sense organ, at least temporarily. People have been deafened by an explosion, and snow blindness is a fairly common affliction in the Arctic. In sight-saving classes for children with serious visual defects, every effort is made to eliminate strong intensities of light by keeping out direct sunlight, by indirect artificial illumination, and even by avoiding highly polished surfaces which might reflect the light.

Duration. All sensations are experienced in time and hence have duration. One result of continuous stimulation of a receptor is *adaptation*, which has been previously mentioned. This is a process which is in part mentally getting used to a thing and in part an actual change or breakdown within the sense organ itself, so that former discriminations become for the time impossible to make. This may be accompanied by a feeling of unpleasantness aroused by too long a continuance of a sensation, no matter how enjoyable the original experience may have been.

Extensity. It is difficult to ascribe special dimensions to sensations of balance, smell, and hearing, though sounds are sometimes described as small or thin and large or voluminous. Other stimuli are more or less accurately described as large or small, as the case may be, according to the amount of space on the end organs covered by them.

Discriminations of size can be made kinesthetically and tactually as well as visually, with considerable accuracy. If one is asked to judge which of two lines is the longer, the longer the lines are, the greater the absolute amount of the error. Accurate estimates of extent in terms of standard units like inches or miles, of course, require considerable practice.

Sense training At one time it was thought by some that since all knowledge comes through the senses, training in

sensory discrimination would be a good way to increase knowledge. This is, of course, true up to a certain point. A knowledge of dyes, or of music, would be enhanced by the experience that fine color and tone discriminations can give. The Montessori system,[10] a school method for kindergarten-age children, employed materials which would give various sensory experiences, emphasizing tactual discrimination. In fact, the children were taught the shape of the letters of the alphabet by having them trace with their fingers enlarged letters made of fine sandpaper.

Whether such materials improved their powers of sensory discrimination or not, and even if such abilities were developed beyond the point of actual need, the scheme has a certain real value. The child gets an idea of rough and smooth or round and square, not only from hearing about them, but from sensory experience with them.

The principle of learning from experience with things may be extended, as it has been by followers of Madame Montessori and by others, to include the gaining of knowledge about other things by experiencing them — by visiting them, observing them, and working with them. So laboratories and shops have come into the schools, exhibits and excursions are organized, works of art are seen and studied, and lantern slides and motion pictures are shown. Knowledge is thus built up on a basis of sensory experience.

Summary. The senses provide the basic data of experience. Certain portions of the body are differentiated to respond to various kinds of environmental conditions. The basic plan is a specially constructed organ in which chemicals or forces impinge on special nerve cells, setting up a nerve current. The sensations reported in consciousness differ according to the organ stimulated. Their various characteristics can be discriminated with varying degrees of acuity.

The senses which are of primary importance to the individual in his school work are vision and audition, in which the various defects that appear demand correction.

QUESTIONS

1. In what ways could you tell if your vision were slightly defective? Your hearing? If that of some one else were?
2. Excursion. If there is one in your locality, visit a school where special work is done for children with visual and auditory handicaps. Write a report of the visit.
3. It has been said that the school itself is responsible for much of the defective vision of children. Do you feel that there is any truth in this charge? What can be done in a school to minimize eye-strain?
4. Suggest ways that you can use objects and visual materials in the subject or grade in which you are planning to teach.
5. What educational practices have been developed for helping the deaf child? The blind child?
6. Trace the recreational and esthetic activities and satisfactions derived from the several senses.
7. What makes some activities involving sensory enjoyment more "worth while" than others? Which ones do you consider most worth while? Why?

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CHAPTER IX

PERCEPTION AND MEANING

The world as sensed and as perceived. In the preceding chapter, the various kinds of sensations and the sensory mechanisms which receive stimulation have been described in some detail. Stimuli are not only sensed as color, tone, odor, and the like, but they are recognized and identified, let us say, as a flag, a melody, or the fragrance of a rose. We know something about them; they are *perceived.* They have some meaning for us.

As a matter of fact we rarely experience a pure sensation that has no meaning, no significance; though sometimes, as for example in the case of a strange noise at night, it is difficult at first to say whether it is someone knocking, a shutter banging in the wind, or the hot water thumping in the pipes In such a case as this, one is more conscious of the sensation itself, until it is recognized.

I. ATTENTION

Focus and fringe. Of course, one never experiences just one sensation at a time. The sense organs are constantly being bombarded by stimuli of all kinds, from which selection is made of certain sights, sounds, smells, and the rest which are perceived and reacted to. The process of selecting from the total number of sensations, or at least of narrowing their range, is called *attention.* The word is a familiar one, and its ordinary meaning is as exact as that of any psychological term in common speech. The teacher wants the pupils to "give attention" to what they are doing; or we say that we did not understand what was said because we were not "paying atten-

tion." In such cases, it is redirection of attention which is sought; for "inattentive" children are attending to something if not to the lesson. The "absent-minded" professor, about whom stories circulate on every campus, is absent-minded because he is attending to other stimuli than those which seem most important to others.

Things which are being most closely attended to at any one moment are spoken of as being at the *focus* of attention, while those we are at the same time only vaguely conscious of are on the *fringe* of consciousness. The matter might be represented by a target on which the rings shade off into one another. The bull's-eye would be the focal point of clearest consciousness, and at the outside edges would be the sensations connected with such automatic acts as winking the eyes or scratching the head, of which one is only vaguely conscious, or perhaps not conscious at all.

Prepotency. Why does one attend to some stimuli and not to others? Or, why, out of all the things to which one might attend, are certain stimuli prepotent, that is, more powerful than others? There are various reasons, some of which are due to what may be called *native factors* because they depend on the inherited nature of the organism; others are due to *acquired factors*, so called because they depend more largely on learning and experience.

Some of the most important *native factors* are intensity, contrast, change, and movement. The very *intensity* of the stimulus — a bright light, a loud noise, a sharp pain — will attract attention, at least momentarily, above anything else. In the same way, differences of intensity will bring out otherwise less noticeable features of a scene by *contrast*. Variety, too, is a matter of remark, setting itself off from the accustomed and the humdrum.

Change in the stimulus, as when a light becomes brighter or

duller, or a noise louder or softer than it has been, is quite sure to call attention to itself, as are unexpected differences in an otherwise familiar scene. And in a similar way a *moving* object is much more apt to catch the eye than one which is at rest. Those whose business is such that they must attract and hold the attention of the people employ devices which embody these factors. The bright intermittent lights of the theater district, the loud voice of the barker at the side show, the gesticulations of the soap-box orator, and the contrasting modulations of the voice of the accomplished public speaker all illustrate a studied adaptation to the use of these native, attention-getting factors Probably one of the reasons the motion pictures are so popular is that they employ all of them so effectively.

But a moment's thought shows that these factors do not tell the whole story. Some stimuli are prepotent because of what is known about them, because of the individual's experience with them. Conditions of this sort may be called the *acquired factors*, and their prepotency may be due to analogy, desire, and consequences.

An *analogy* is a partial identity. Two quite different situations may be alike in one respect; hence they are said to be analogous. You may meet a person for the first time, and he attracts your attention because there is something about his eyes that reminds you of someone you have known. Or in a strange city your attention is caught by a building or square like one you have seen elsewhere; and so strong does the resemblance seem that you may have the feeling that you have been there before.

Objects of one's *desire*, things for which one is looking, are quite apt to stand out from other stimuli to such an extent that one may be quite unaware of any of the things around them. A well in a desert, or a certain kind of suit in a store

window, attracts attention because one desires and is looking for just that thing.

And lastly, the objects which are known to have *consequences*, for good or ill, come to the focus of attention with startling vividness. The rustle of a rattlesnake will drown out much louder noises for the hunter who knows its significance. Similarly the leaves of poison ivy or of field strawberries, the traffic policeman's upraised hand or the highway number on a strange road, a child's frightened cry or restful breathing, and the smell of escaping gas or broiling steak — each has its possible consequences and would probably not be attended to particularly if the individual did not have some knowledge of its significance.

Prepotency and instruction. The prepotency of a stimulus may result in a mere temporary focus of attention upon the object, or there may be some further response. From one point of view, the whole learning process, which is the school's concern, may be thought of as finding out what things to respond to and how to respond to them. How, then, is it possible to enable children to attend to the important or necessary things?

It would hardly be recommended that the teacher should put up electric signs or employ the methods of the side-show barker to attract children's attention to what is to be found inside the tent of learning. But the opposite course, that of dull monotony, can be avoided — monotony in speech, in room decoration, and in class procedure. Movement can be applied to teacher and pupils alike to get both away from their desks, while intensity, contrast, and change can become matters of emphasis and variety, within reasonable limits. An occasional "red-letter lesson" has been suggested,[1] dealing with something distinctly worth remembering in a way that will long be remembered.

When it comes to giving children the information which will make them attentive to what would otherwise be unnoticed, the problem broadens out to limits far beyond the scope of this chapter. Many dangerous things, both natural and mechanical — fire, deep pools of water, edged tools, passing automobiles, and the like — they learn about at home, though schools recognize the necessity for continuing and supplementing parental instruction with cautions, safety campaigns, and pupil patrols. The more elusive social stimuli that one must learn to recognize, though many are impervious to them — like rudeness, signs of rising wrath, falsehood, and deceit — present even greater difficultics; and there are those who question whether schools should do more than allow them to take care of themselves incidentally in the rough-and-tumble contacts of the street and playground.

Identifiability and cues. But with intellectual matters the school is traditionally concerned, and certainly in this field children must be taught to identify[2] the part of a situation to which they should become attentive and to which they should respond, whether it is a question mark or a decimal point, a verb ending or a dollar sign. When children know what to look for in a task set them, know the handle to take hold of, as it were, the work is already half done. In every subject, not only in the elementary school but in high school and college as well, learning would be greatly facilitated if the teacher consciously trained the children to look for cues, that is, for signs which point the way to what is to be done.

2. APPERCEPTION

Perception and ideas. When an object is perceived, and its meaning for the individual perceiving it is to be emphasized, the term apperception is sometimes used. For example,

several people are looking at a house. They all perceive it. That is, the various visual sensations of color, light, and shade in a certain pattern are interpreted in the same way, so that no one of them thinks it as a tree or a hill. But the landscape designer sees it in relation to its lawn and the planting around it, the builder sees it as well or poorly constructed, the architect as representing a certain style, the tourist as attractive or quaint, the real estate man as property having a certain value, and the prospective buyer as a place which may or may not be desirable for housing his family.

Professional experience is a very strong determiner of the way in which things or events are apperceived. An automobile accident, to use another example, is viewed very differently by the victims and by the doctor, the lawyer, the insurance man, the traffic policeman, and the auto mechanic.

Everyone sees the world through the spectacles of his own experience, and the mental accumulation of experiences with which he interprets his environment has been called his *apperceptive mass*.[3] The term gained popularity through the influence of the German psychologist and philosopher Herbart (1776–1841), and the ideas dominated American educational practice for a number of years during the last decade of the nineteenth century and the first decade of the twentieth.

Herbartian method. The main point of the Herbartian method is that children as well as adults understand a thing only in terms of the experiences which they have had. It is necessary, therefore, to re-present such experiences to them as will help them to understand the new ideas embodied in the school subjects they study, or at least to have them recall the experiences needed for better comprehension.

For in addition to *past experiences*, what one happens to be thinking about at the time is an important determiner of the way in which new experiences are apperceived or apprehended.

Thus, when a new animal is studied in biology, the things the children already know about it, or some of the things they have learned in regard to other species, will direct their thinking along lines which will help them to understand the new assignment. Likewise a review of similar or recent historical events will recall those things which will help them to understand a treaty, new legislation, or a supreme court decision.

Herbart and his followers worked out what are known as the *five formal steps*[4] in instruction: preparation, presentation, association, system, and method or application It can be seen that these steps refer very definitely to subject matter. And while recent educational theory has tended to emphasize the child and his activities instead of the more passive learning of facts, nevertheless there is still a place for the careful instruction which was based upon the Herbartian system.

3. PERCEPTION

Time. For the perception of time, various kinds of clocks marking off the passage of time and based upon the regular movement of the sun have made it unnecessary for man to depend on the more irregular rhythms of his own body.

The passage of time is perceived by everyone, though in different ways. For children, four hours to play is a lifetime of bliss, and a fortnight an eternity. One father, as a punishment, took away his five-year-old child's sled for two weeks. The first afternoon the child was very unhappy; then he apparently forgot he had a sled. As people grow older, a day seems to pass in an hour, and the years glide by as the months did before. But for shorter periods, emotional excitement and boredom create illusions in regard to the passage of time. People sometimes say, "I thought the hour would never end,"

or "The time was up before we realized it." Subjective judgments rarely agree with the clock.

Nevertheless there are rhythms of the body which recur with considerable regularity: the pendulum-like movements of the arms and legs, the heart beat, and at longer intervals the so-called peristaltic movements of the stomach interpreted as hunger pangs, and the sexual rhythms.

Organic and kinesthetic senses participate in rhythmic time perception, and rocking chairs and swings, and parades and dances testify to the fundamental nature of rhythmic satisfactions. But the ear is the most accurate judge of small differences in time intervals, in which ability considerable improvement can be made with practice. Tests of musical talent previously mentioned measure among other capacities the ability to discriminate nearly equal periods of time about a second long, and nearly equal rhythmic patterns.

Space. The distance between objects in a two-dimensional relationship is judged by the area covered on the surface of the skin, as in the esthesiometric tests for two-point threshold, or on the retina. Or it may be judged kinesthetically in terms of movement. The cues that give a knowledge of distance are very elusive, whether they come from the movement of the hands and arms, from the muscles of the eyes in looking from one point to another, or from the vestibular sense reporting movement of the head.

Judgments based on experience are constantly used, as they are also for three-dimensional perception, that is, of the relative distance of objects away from the receptor. If two objects are known to be about the same *size*, the one that looks smaller is judged to be farther away because of perspective. (See Fig. 41.) And when by the *interposition* of one object between the observer and another object, the first cuts off the view of a part of the second, the latter is judged to be farther

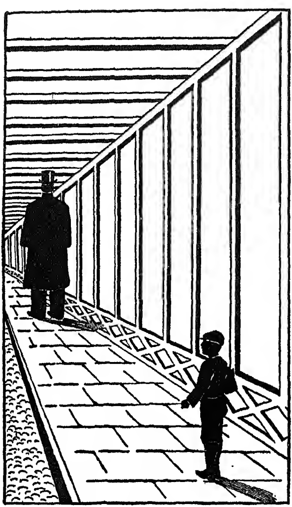


Fig. 41. Size and Perspective [5]
In spite of appearances the figures of the boy and the man are the same height.

away. Hills and trees lacking in *clarity* of color and outline are farther away than those showing more detail, though fog or a rarified atmosphere sometimes upsets this criterion.

Then, too, *binocular vision* aids in space perception, since with two eyes one can see on both sides of an object to a limited extent, which makes it seem to stand out in three dimensions more clearly than it otherwise would. Many people used to have stereoscopes in their parlors, through which they and their guests looked at double pictures on cards. Such pictures are taken by a camera with two lenses side by side about as far apart as the eyes. The stereoscope forces each eye to look at the picture in front of it, so the two views are blended as in normal vision, giving the same sense of perspective. Contrariwise, unfamiliar objects looked at with one eye, if the other criteria mentioned are disregarded, are apt to seem flat, one right against the other instead of some distance behind it.

Movement. The actual motion of objects can be visually perceived if it is not too slow, as in the movement of the hour hand on a clock, or too fast, as when a whip is snapped, though a slight retardation produces a streak or blur which is interpreted as movement. The same senses that contribute to a perception of space — the tactual, kinesthetic, and vestibular — also report movement of objects and of the body, but the visual sense is the one most relied on.

The eyes, however, also report movement that does not take place, which is fortunate for motion-picture lovers and promoters. Such pictures are really separate, but they are presented successively. Thick booklets with tiny pages to whirr have been made which produce the same effect though less artistically. If in such a booklet, dots were placed a little farther to the right on successive pages, they would look like one dot moving as the pages are buzzed. If the distance is a

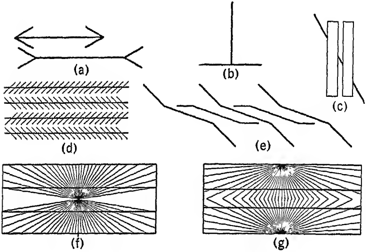


FIG. 42. OPTICAL ILLUSIONS

(*a*) Müller-Lyer Illusion. the horizontal lines appear to be of unequal length; (*b*) overestimation of the vertical; (*c*) Poggendorff Illusion the transversal appears to be out of alignment; (*d*) Zollner Illusion the horizontal lines do not appear so, (*e*) Lipps Parallels· the middle sections of all the lines are parallel, (*f*) and (*g*) Hering Illusion the horizontal lines appear to curve in the middle

little too great, the movement is more jerky. If greater still, the illusion of movement vanishes. But if the conditions are right, in the matter of time and spacing, as they are in most motion pictures (16 exposures per sec.) the illusion is complete: the observer perceives perfectly smooth movement.

Illusions. Sometimes objects are perceived in a way which does not correspond to what is known about them. Such errors of perception, which are called illusions, are not peculiar to certain people, but are experiences which all have in common. The temperature or thermal illusion of adaptation, illustrated by the experiment with the three bowls of water, was mentioned in the preceding chapter. An illusion of tactual space perception appears when the points of a drawing-

compass are a quarter of an inch apart and are placed on the cheek, where they are felt as one point, and then drawn lightly across the lips, where they are felt clearly as two, and on to the other cheek where they seem to come together again.

The visual perception of motion when there is none, called the stroboscopic illusion, has just been mentioned. One sometimes obtains an illusion of motion when he is in a stationary railroad train and through the window sees the train on the next track pull out. Similarly, the moon rather than the scudding clouds sometimes seems to be moving. A series of geometric optical illusions is shown in Fig. 42.

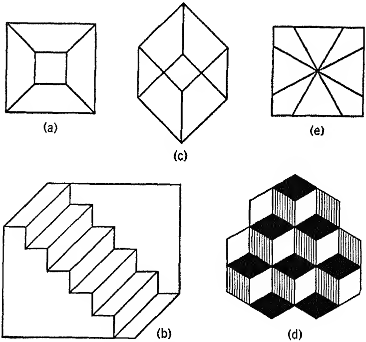


FIG. 43. AMBIGUOUS FIGURES

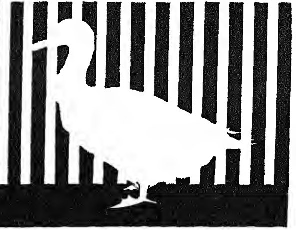


FIG. 44. FIGURE AND GROUND IN PERCEPTION [6]

The white outline of the duck seems to stand out in front of the white stripes which form the background, and the latter seem to accompany the black stripes behind the figure as ground.

Another type of illusion, involving reversible perspective, is to be found in the so-called *ambiguous figures* (see Fig. 43). The square figure (*a*) will seem to be three-dimensional, either like a long hall down which one can look, or like the top of a square lampshade viewed from above, a "truncated pyramid." The staircase (*b*) seems now to be viewed from above and now from below. The reversible cube (*c*) now brings its upper, now its lower midpoint toward the observer. The number of cubes in the pile (*d*) changes according as they are viewed as if from above or from below. And the angles (*e*) pointing to the center may seem at first to occupy the foreground, like broad ribbons diagonally around a box of candy, and then suddenly recede, and the conventionalized Maltese cross will stand out from the rest. In none of these cases is the experience of the shift a continuous one; instead, one discovers of a sudden that a change has taken place.

The perception of wholes. Without trying to do so, and without any more experience one way than the other, one sees these ambiguous drawings as patterns. A part is foreground and the rest is merely the supporting background. But they are drawn in such a way that what was foreground can just as well be background, and vice versa. Thus the pattern changes.

This reversal of *figure and ground*, as the phenomenon is called (see also Fig. 44), brings rather sharply to view a characteristic of perception that is very significant; but because it is so common, it is apt to be neglected. Perception is apparently the sensing of prepotent stimuli as forms or patterns or wholes. Analysis discloses the parts as they are in themselves, nevertheless, by themselves the parts are just lines. The total pattern gives them some of their peculiar characteristics. Thus, Fig 45 is just a row of parallel lines, some nearer together than others. Yet those nearer together are seen as pairs of lines with one left over at the right; it is practically impossible to see the more distant ones as pairs with one left over at the left. If, however, the drawing is modified, as in Fig. 46, by the drawing in of little lines at the top and bottom, thus partially enclosing the space between them, the groups appear as it was impossible to make them before. One tends to see as a whole those which wholly or partially enclose space.

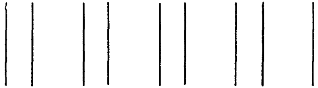


FIG. 45. GROUP FORMATION
(After Köhler.[7])

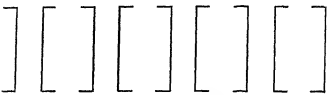


FIG. 46. ENCLOSED AREAS
(After Kohler.7)

This comes out more clearly in the case of certain geometric figures. Probably no one, upon seeing Fig 47 without reading what follows, would notice that each part contains a capital letter, which is just as much present geometrically as the larger figure, in the formation of which it is absorbed. When, however, it is pointed out that in Fig. 47, the (*a*) design contains an *E* and the (*c*) design a *K*, the way is open for the discovery of the hidden letters

It is shown by the Gestalt psychologists, who have been very active in calling attention to these phenomena of perception, that in many cases the figure, though unfamiliar in outline, stands out more prominently than a part (like the *E* or *K*) which by itself has been experienced very often. And further, that unless the part is seen as a pattern in a larger whole, a subject will not be able to say that he has ever seen

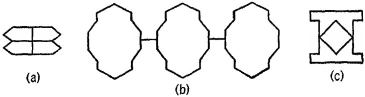


FIG. 47. HIDDEN LETTERS
(After Köhler 7)

it before; much less will he be able to remember what he has never really thus "seen."

4. PERCEPTION IN READING

What is reading? Reading is essentially a perceptual process. The pure visual sensations involved in reading a sentence are only of irregular stimuli in contrasting shades of gray, called black and white. Meaning is attached to the marks only through experience and training. Primitive picture writing (Fig. 48) conveyed meaning to those who could interpret it; but the process of conventionalization of the symbols continued until the alphabet was evolved (see Fig. 49), in which a symbol came to represent a single sound instead of an idea, an object, or even a syllable.

For our present purposes, we shall restrict the definition of reading so that it includes only the perception of written or printed words which are in the speaking vocabulary of the

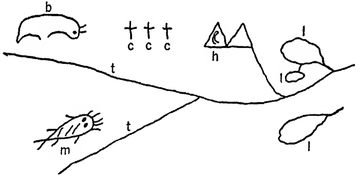


FIG 48. PRIMITIVE PICTURE WRITING [8]

This is an Ojibwa love-letter. The writer whose totem is the Bear (*b*) invites her lover of the Mud Puppy totem (*m*) along devious trails (*t*) and past lakes (*l*) to her home (*h*) from the door of which a beckoning arm welcomes him. The crosses (*c*) indicate that the Bears are now Christians

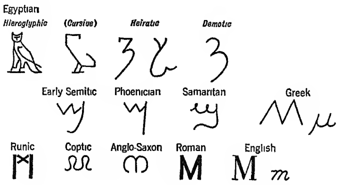


FIG. 49. EVOLUTION OF THE ALPHABET — THE LETTER M [9]

reader. Thus the problem of the acquisition of new and abstract meanings, which was touched on in connection with apperception, is deferred until a later chapter.

Even apart from the influence of visual acuity and defects, many experimental studies have been made of reading.[10] Most of these are on the visual processes themselves, on reading efficiency including rate and comprehension, on teaching children to read, and on the choice of materials to be read.

Visual processes. Contrary to what is usually supposed, the eyes do not move smoothly along as they follow a line of print. Instead, they go by jerks, pausing to focus somewhere on a word or phrase, moving swiftly to another point an inch or so farther along, and perhaps jumping back again to pick up something that they missed, and so on. It can be readily understood that this involves a very complicated series of muscular adjustments, and there is small wonder that the eyes become tired when kept at the task of reading continuously for long at a time.

The eye movements may be observed easily enough by having a person hold a book he is reading in such a way that

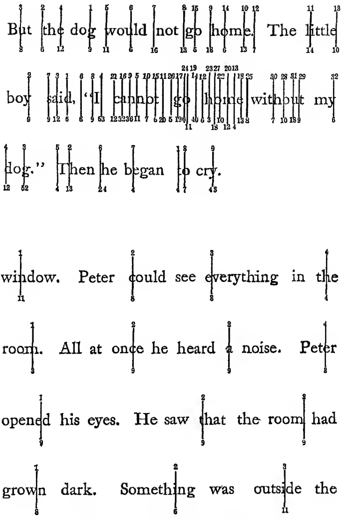


FIG. 50. EYE-MOVEMENTS IN READING [11]
The numbers above each vertical line show the order of the fixations; those below, the duration.

one may look into his eyes. After a series of trials which included attaching a thread to the eyeball itself, an experimental technique has been worked out whereby it is possible to determine just where on a page the *eye pauses* occur, and their duration The method consists in throwing a beam of light onto the cornea of the eye from the side, so that the light is reflected by the eye to a moving camera film. The developed film is later compared by projection with the words read, so that the finished analysis is of the type shown in Fig. 50.

For an adult who is an ordinarily good reader, the fixations or eye-pauses average about five or six to an ordinary line of print and last for a fifth of a second each. Proficiency at this level is normally very nearly reached in the fourth or fifth grade. Younger children and slow readers not only have a larger number of fixations per line, but their eyes jump too far, sometimes, and then they move back again to see what was skipped. Such recessive movements are particularly frequent after the long swing back to the beginning of a new line which is often missed the first time. These corrective fixations, as they are called, are time consuming and hence inefficient, and are gradually eliminated as the pupil improves in reading.

Efficiency in reading. Silent reading should be much more rapid than oral reading because the eyes can take in the words more rapidly than the vocalizing apparatus can pronounce them. In oral reading, the eyes have been shown to be as much as four words ahead of the voice. In silent reading, to which the schools have given little attention until comparatively recently, the vocal processes need to be eliminated entirely. Whispering the words and lip movements of pronunciation slow down the whole process to an enormous extent.

A number of silent reading tests[12] have been constructed

which aim to measure the rate of reading of different pupils. A passage is presented to the child to read, and the time he takes to read it is recorded. If a large number of children are given the same passage, under the same conditions, comparisons may be made of their speed, and the rate of reading of an individual child can be compared with the average to determine what his ability is in relation to the others.

The significance of measures of rate of reading is lessened because of the factor of *comprehension.* One should know whether or not the child is really reading, whether he understands what he reads, or whether he is just skimming past the words without comprehending them. To get a check on his actual performance, various devices have been worked out. One includes a short list of questions on each of the paragraphs read, which may be answered very quickly. Sometimes a list of statements is given, and the one tested is asked to check those which are correct. For younger children, a series of pictures is presented, and the child must read the directions underneath in order to know what addition he is to make to the picture. Another test asks the pupil as he reads to cross out certain words which do not belong in the passage.

In spite of the fact that such devices are a distraction, in that they involve doing something which a person does not ordinarily do when reading to himself, they yet serve their purpose, and the individual scores made on such tests when compared with the average scores of large numbers of children form a much better basis for judgment as to a pupil's reading ability than can be made by a parent or teacher without the help of such comparisons.

Experimental studies have shown that considerable improvement in rate of reading can be made, still keeping comprehension to the point where the person knows just as well what he is reading as when he reads more slowly. But unfortu-

nately no automatic device can be offered for speeding up reading, though many have been tried.[13] The only way seems to be (*a*) to keep the mouth closed suppressing all lip and tongue movements, and (*b*) to force oneself to read faster. However, with such simple directions, subjects have increased their rate of reading surprisingly, and some have found themselves after practice capable of reading twice as fast as they did before.

Teaching reading. While it is not the purpose of this book to go into problems of teaching method, the question of *phonics* should perhaps be mentioned because of its psychological basis and the controversy it has aroused.

Teaching reading by the use of phonics[14] or the phonetic method means teaching children to pronounce words by the sound of the letters. The chief objections to this method are two. One lies in its history, seeming to revive as it does an earlier method according to which letters were learned first, then two-letter words and sounds, three-letter words and sounds, and so on. This wearisome drill method was so overdone that a reaction set in against it.

The other objection to the phonetic method has grown out of the research studies which seemed to discredit it. These have shown that people tend to perceive, not separate letters but words and phrases. Whole words, and sometimes quite long ones, which are in children's spoken vocabulary are recognized, seemingly by their general form, quite as easily and often much sooner than are short words. Thus one first-grade child could read "zeppelin" before he could read "cat."

However, it is generally unwise to carry reaction too far. If children know the usual sounds of the letters, they can advance more rapidly themselves in the reading of words with the pronunciation of which they are already familiar. It is true that English-speaking children are handicapped some-

what by the fact that the same letter has several different sounds, and in some words no sound at all, while their Italian cousins, for example, very early can pronounce any word they see (as well as spell any word they hear pronounced) because of the phonetic character of the Italian language.

Nevertheless, even in English, the phonetic method, if it is not overdone, is serviceable in supplementing other methods, particularly as it aids children to recognize words they have not previously seen by building them up from the separate parts or syllables with which they are familiar.

Reading materials. Great changes have taken place in the books for children during the past fifty or seventy-five years. The most obvious change is in their form and appearance, as the samples in Fig. 51 show.

Another change is to be found in the material itself, the kinds of stories, and the plan of the readers. Children are no longer forced to read dry moral tales, but instead have illustrated stories about things in their own environment, which are intended to encourage them to explore it further. One of the reasons for the change in the attitude of children toward school from something they heartily dislike to a place they enjoy is no doubt due in no small measure to the character of the books with which they are provided.

Still another change which is less obvious but no less important is the attention which has been given in recent years to adapting the words and the stories to children of different ages. For the words, studies have been made to find out which ones are used most frequently in common speech, letters, newspapers, and magazines. Supposedly children can more profitably spend their time in learning these words than they can others which are rarely used. Probably the best-known study was made by E. L. Thorndike and culminated in the *Teachers' Word Book*,[15] which gives an alphabetical list of the 10,000

(1)

(2)

FIG. 51 (*a*). CHILDREN'S BOOKS — OLD STYLE

(1) A page from an illustrated children's book of the year 1818 Facsimile (in original size) from Trip's *History of Beasts Being a Trifle for a Good Boy* Ornamented with engravings.
(2) The first page of an early illustrated alphabet Religious and moral themes, appeared in *The New England Primer or, An Easy and Pleasant Guide to the Art of Reading* Adorned with cuts to which is added *The Catechism*. 1824.

Fellow was not there. Instead, an ugly black monster machine was doing something most peculiar.

Bang, bang, ***bang***! Bang, bang, ***bang***! went the monster. It was a pile-driver hammering, p o u n d i n g, hammering, pounding.

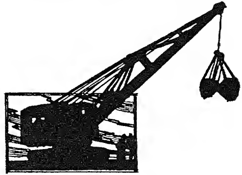
Ned was disappointed. He had expected to see Big Fellow. He wanted to see Big Fellow. Had Sandy made a mistake? Wasn't Big Fellow going to work on the new bridge, after all?

Bang, bang, ***bang***! went the pile-driver. Bang, bang, ***bang***! What was it doing? Ned watched. It was driving steel sheets down into the river bed. What for?

Ned did not find out that day, nor the next, nor the next. Every day he came

{70}

back to see if Big Fellow had arrived on the job. Again and again he came upon the pile-driver hammering, pounding.



The steel sheets that it drove down into the river bed seemed to be ***fencing in*** part of the river.

But one day he came upon something

{71}

(3)

FIG. 51 (*b*). CHILDREN'S BOOKS — NEW STYLE

Acknowledgment is hereby made to Harper & Brothers, New York, for permission to include facsimiles (reduced one half) from *Big Fellow at Work*, by Dorothy W. Baruch, illustrated by Berta and Elmer Hader.

words found to occur most frequently. Similar lists have been provided for technical and foreign vocabularies. Efforts have been made to place these words in the books and spelling lists according to their use and to their difficulty for children at different grade levels.

Studies have also been made to discover the ages at which some of the best juvenile fiction is most enjoyed, so that books for recreational reading can be recommended to children with less danger that they will think them "dry" or "too deep," or silly and childish. One of the best of these lists of titles, compiled thus scientifically, is the *Winnetka Graded Book List*.[16] Such selected material provides better motivation and hence aids in developing good reading habits.

Summary. Only those stimuli which are prepotent in some way are selected and attended to. Instruction necessarily seeks to make significant elements thus prepotent, serving as cues for desired responses. Past experience is important in the selection of cues and in the meaning which is given to sensory experiences. The Herbartian concept of apperception is significant in the direction it gives to instruction.

Perception is sensing things in their varied relationships so that meaning is given to them. Wholes of varied complexity are perceived, and the learner must connect visual and auditory symbols with meanings as in reading.

QUESTIONS

1. Describe the experiences you have gone through in trying to identify a strange noise at night; the taste of some flavor; a person you cannot "place" but remember having seen before Did the sensations seem to change during the process?
2. Is there a sharp line of demarcation between what you are attending to and what you are not, that is, between focus and fringe? Illustrate.

3. Can you distinguish between the fringe of conscious attention and peripheral vision? How?
4. What kinds of things distract your attention? Are you more attentive to certain stimuli at one time than at another? Illustrate.
5. What things attract your attention when walking in the fields or woods or along a city street? When visiting a class. Explain.
6. What kinds of advertisements catch your eye? Should school books copy advertisers' techniques? How could books be improved?
7. List some of the cues that pupils should be on the lookout for in connection with the different school subjects; with social living.
8. Admitting that some material should only be skimmed, and that some must be studied, is it profitable to develop different "speeds" in reading? Would more than two speeds be needed?
9. Visit a class in beginning reading and observe the methods being used. Note in particular the emphasis placed upon (*a*) phonetics, and (*b*) pupils' experiences.

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5. From E. H. Cameron, *Psychology and the School*. New York, Century, 1922, Fig. 20. By permission.
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9. I Taylor, *The History of the Alphabet*. New York, Scribners, 1899. By permission.

10 A I Gates, **Interest and Ability in Reading.* New York, Macmillan, 1930.

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12. A number of reading tests have been devised, some of the most widely used of which are listed below:

Burgess Scale for Measuring Ability in Silent Reading, Picture Supplement Scale 4, for Grades 3–8. Courtis Silent Reading Test. Haggerty Reading Examination; Sigma 1 for Grades 3–5; Sigma 3 for Grades 6–12. Monroe Standardized Silent Reading Test. Test I for Grades 3–5; Test II for Grades 6–8. Stone Narrative Reading Tests, for Grades 3–11.

To these should be added the following: Lee-Clark Reading Readiness Test, Stone and Grover Classification Test for Beginners in Reading, Metropolitan Readiness Test, Van Wagenen Reading Readiness Tests, Betts Ready to Read Tests, and Monroe Reading Aptitude Tests.

13. E. B. Huey, *The Psychology and Pedagogy of Reading.* New York, Macmillan, 1922.

14. A. I. Gates, **Reading.* New York, Bureau of Publications, Teachers College, Columbia, 1931, chap. IV

15. E. L. Thorndike, *The Teachers' Word Book.* Teachers College, Columbia University, 1921 (2d ed 1927).

16. C. Washburne and M. Vogel, *Winnetka Graded Book List.* Chicago, American Library Association, 1926. Results of a statistical investigation as to the books enjoyed by children of various ages and measured degrees of reading ability.

Attention and perception are described in their various aspects in *Readings in Psychology*, chaps. XVII and XVIII Some selections on Reading appear in chap. IX at the *Readings in Educational Psychology*. A number of experimental studies of perception including Köhler's work are reported in *Great Experiments in Psychology*, chaps. XI and XIII.

CHAPTER X

MOTOR RESPONSE

Learning and doing. Nowadays, more emphasis than ever before is placed by educators upon performance. It is realized that children not only learn *to do* certain things, but that they learn *by doing* them Even the meaning of words and objects, which was spoken of in the preceding chapter, is often in terms of what one *does* with them, quite as much as the way they look or what they are made of. A spoon, a chair, or a football is an object one does something with, five-year-old children's definitions are uniformly made in terms of use.

The school curriculum, therefore, has come to be viewed not so much as "subjects" which must be learned, but as a selection of activities to perform or take part in. Sports and hobbies as well as shop and laboratory work are introduced into the school program not just to give the children a pleasanter time, but in the belief that participation in different kinds of situations is the way of most effective learning.

I. PHYSIOLOGICAL BASIS OF BEHAVIOR [1]

Sense organs. The activity of pupils consists of their response to various kinds of situations. While behavior itself is a function chiefly of the muscles which move the body or its parts, the movement is effected by the connecting and coordinating mechanisms of the nervous system. It has been pointed out that various forces — sound waves, light waves, chemicals, etc. — affect certain parts of the body known as sensory receptors or end organs in such a way as to set up a

nerve current which travels by way of the spinal cord and brain to the appropriate muscles.

Nerve fibers. The nerves which thus connect the sense organs, muscles, and glands with the spinal cord and brain (Fig. 52) are bundles of fibers somewhat like an electric cable. Each one of these fibers is a part of a nerve cell or *neuron* (sometimes spelled neurone). Several different kinds of neurons are shown in Fig. 53. Other bodily cells like the stationary bone cells, the blood cells (corpuscles) which travel with the blood stream, and the rest, are less complicated in their structure than the neurons. All, however, are bits of protoplasm with a nucleus, in which respect they resemble the one-celled or unicellular creature known as amoeba. They resemble it, too, in the way they behave, in the way they eat and grow and die. The neurons have these things in common with other cells, but in addition they have certain characteristics of their own: they are *sensitive* to stimulation; they can *conduct* or transmit, so that the action started at one end is effective at the other; and they can be *modified* or changed by use so that they behave differently as a result of use. Habit formation is possible because of changes in the neurons.

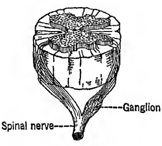


FIG. 52. CROSS SECTION OF CORD AND SPINAL NERVE

Besides the cell body proper, which is microscopic in size, a neuron has two main parts or processes which grow out from it, the *dendrites* and the *axon* (sometimes spelled axone). Axons (Fig. 54) are sheathed or *medullated* much as electric wires are insulated.

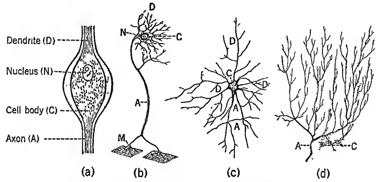


FIG. 53. DIFFERENT KINDS OF NEURONS

(*a*) Bipolar cell, (*b*) motor neuron, (*c*) cortical cell, (*d*) Purkinje cell

When a sensory receptor is stimulated, there is set up an *afferent* nervous impulse, that is, conduction is toward the centers — the spinal cord and brain. The dendrites of the sensory neurons connected with the receptor pick up the nerve current and transmit it along their entire length to the cell bodies, which are located in clusters called *spinal ganglia* along the outside of the spinal column. Thence the current travels along the axons of the sensory neurons to the branching dendrites of connecting neurons in the spinal cord, always passing in any one cell from the dendrite through the cell body to the axon.

The connecting neurons transmit the current to the brain or perhaps, as in the case of the spinal reflexes, directly to the branching dendrites of the motor neurons. The dendrites and cell bodies of the motor neurons are for the most part located in the spinal cord; and their axons, in the form of bundles of long, smooth fibers composing the spinal nerves, carry the efferent impulses to the different muscles with which they are connected. The diagram of the stimulus-response arc as it appeared in Fig. 1 can now be somewhat elaborated, as in Fig. 55,

FIG. 54. LONGITUDINAL SECTION OF A MEDULLATED NERVE FIBER

though here, too, it is of course presented diagrammatically in an over-simplified form.

There are many problems of neural action that the neurologists have not yet solved One of these is the nature of the nerve current, which can be loosely defined as a chemical change, though not so devastating as the chemical change in a lighted gunpowder fuse when the fire travels along it.

Another and complicated problem has to do with the direction which the nerve current takes. The point of contact

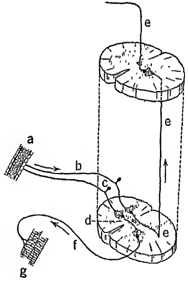


FIG. 55. SPINAL CONNECTIONS OF SENSORY AND MOTOR NEURONS

a, Sensory receptor; *b*, afferent fiber, *c*, sensory cell body; *d*, synapse and motor cell body; *e*, connecting neurons and spinal tract, *f*, efferent fiber; *g*, effector.

between the dendrite of one neuron and the axon of another is called the *synapse*. Some synapses, such as those involving the reflexes and organic movements, act like railroad switches, so constructed that by original nature the current passes over them. Learning probably involves some kind of change at the synapse which is not well understood, but which permits easy transmission of the nerve current when habits are well formed.

Spinal cord. The spinal cord, surrounded and protected by the vertebrae of the spinal column or back bone, serves in part as a reflex center, as illustrated in the diagram (Fig. 55). It is also the means of transmission of neural currents (brought in by the sensory neurons) to the brain and from the brain to the motor neurons along which the current passes to the muscles. Hence diseases which injure the spinal cord, like spinal meningitis and infantile paralysis, result in loss of function of the muscles which the injured fibers should innervate.

Although the structure of the spinal cord is very complicated, neurologists, by studying cross sections under the microscope, have traced different bundles of fibers throughout its entire length. The outside layer is whitish and is made up mostly of medullated nerve fibers extending lengthwise. Inside this layer is a tube or column which in cross section suggests a butterfly with extended wings, and which is gray because it is largely made up of unmedullated cell bodies. In the center is a small hollow tube, the spinal canal, in which the spinal fluid is found.

The brain. The spinal cord enlarges at the upper end, forming what is sometimes referred to as the more primitive part of the brain, which serves as a reflex center — like the brains of some of the lower forms of life, the earthworm, for example. From it branch out the so-called *cranial nerves*, most of which

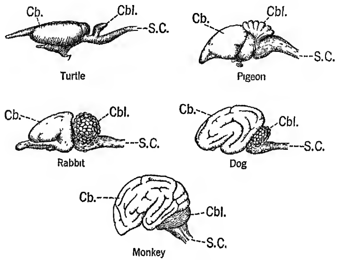


FIG. 56. BRAINS OF SOME OF THE LOWER SPECIES — LATERAL VIEWS
Cb, cerebrum; *Cbl*, cerebellum; *S.C.*, spinal cord

transmit the impulses for the facial muscles or connect with the sense organs located in the head.

As one goes up in the animal scale (Fig. 56) through the fishes and reptiles to the mammals, this older brain becomes more and more covered over with the *cerebral hemispheres*, which have their highest development in man.

The Greek philosopher, Aristotle, thought that the brain served as a cooling organ for the hot animal passions, and many are the theories and speculations as to the nature of the brain which have been put forward since his day. In more recent years, the brain has been likened to a telephone switchboard, making connections and shunting messages over some eleven billion neurons. Of late years, as a result of experiments that have been performed on the learning of rats with parts of the cortex removed, a more dynamic doctrine has been put forward, which views the brain as operating more as a whole

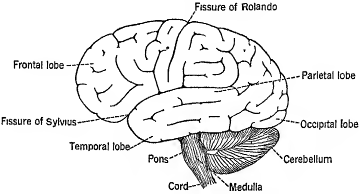


FIG. 57. THE HUMAN BRAIN — LATERAL VIEW

than in segments. At any rate, the size and shape of the area removed have been found to effect a rat's learning more than its location.

Structurally the brain consists of two main parts, the *cerebellum*, at the base of the skull, which contains a most amazing network of nerve fibers, and controls much of the interoceptive and other organic activity, and the *cerebrum*. The latter is much larger, filling the upper portion of the skull, and is divided down the middle by the median *fissure* into two parts or *hemispheres*. The *cortex*, or covering, is very much creased by other fissures demarking the different *lobes* of the brain (see Fig. 57). It is about an eighth of an inch thick and made up, like the inner part of the spinal cord, largely of unmedullated neurons, giving it a grayish color; hence it has often been referred to as "gray matter." While the pickled specimens are rather firm, the living brain is soft and spongy, and peculiarly enough quite insensitive to pain.

While much of the cortical area is undifferentiated, yet some parts have certain specific functions The motor fibers of the so-called pyramidal tract which connect with the muscles

of the arms and legs, after collecting in the spinal cord, spread out like a fan across the cerebrum, making a broad band in the cortex just back of the fissure of Rolando (see Fig. 57).

Not only have the fibers been traced, but brain injuries in these areas produce a paralysis of the limbs. Owing to the fact that the fibers cross in the brain between the cord and the cortex, a severe injury on the left side of the head produces paralysis on the right side of the body, and vice versa. With massage and exercise, most of such paralysis will disappear, uninjured fibers supposedly taking over the work.

In a similar fashion certain sensory areas have been located injury to which interferes with or destroys the corresponding sensory functions. Also, injury to the regions around the sensory areas, in the temporal and occipital lobes where neurons connect them with other parts of the cortex, may produce *aphasia*, or the inability to read or to talk coherently. Some forms of stammering are supposed to result from the development of more than one coordinating speech area, which some think occurs at times when left-handed children are forced to write with the right hand.

Apart from a number of neural pathways, which have been traced, and the effect of certain disease conditions, little is known of the physiology of the brain. Psychologically, however, the cerebral cortex affects the higher types of organization which are called mental, and which form the major part of the subject matter of this volume.

Muscles. Sensory receptors are connected by means of the nervous system with the musculature of the body. The muscles are conveniently classified under two headings. One kind of muscle tissue is called *striped* or *striated* because of its texture, and skeletal because it moves the skeleton around. The striated muscles are the ones that bulge in the arms of the athlete, and in animals are the "lean meat." The other kind of

muscle tissue is called ***unstriped*** or ***unstriated*** or *smooth* because of its texture, and ***organic*** or ***visceral*** because it makes up the muscular structure of the internal organs or viscera. It is responsible for the movements of the stomach and intestines, for example.

Most of the striated muscles are subject to *voluntary* control, that is, they may be moved or not as a person wishes. The unstriated muscles, however, are involuntary and *automatic* in their activity, indeed, an individual is not usually aware of whether they are functioning or not Of course, involuntary movements of the skeletal muscles, too, are common enough, as when one sneezes or is pricked with a pin. And striated muscles may become automatic in their action too, as in the case of any muscular skill. In fact, a large portion of the work of education is the training of groups of muscles to act automatically in a nicely coordinated fashion.

2. THE REACTION EXPERIMENT

Just as it is helpful to analyze a chemical compound into its elements, or a complex sensory experience into its parts, so behavior can be better understood if it is studied in its more elemental forms. However, a single response involves a stimulus, neural connections made up of no one knows how many spinal and cortical neurons, and a rather complex muscular coordination; so while it may be thought of as a unit, it is by no means simple.

The Greenwich episode. The reaction experiment was the answer to a problem which arose outside the field of psychology — and rather dramatically, too, at least for the persons concerned. It seems that before the United States Coast Survey invented a mechanical device for the purpose, the method of obtaining correct Greenwich Observatory time was by making

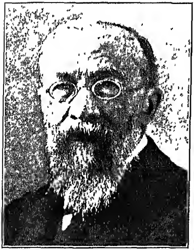
a record of the moment the star being observed through a telescope crossed a fine line in the eye-piece. The observer was expected to time the stellar transit to a tenth of a second by listening to a clock ticking once a second; but the results obtained by one assistant in the observatory differed by nearly a whole second from those of his chief; so he was discharged for incompetence.[2]

Later study of the case showed that even trained observers differed widely in their readings of stellar transits, but that their error was constant. The equation which expressed the amount of their error, which, as was later realized, was due to differences in reaction time, came to be known as the personal equation.

Wundt's contribution. Wilhelm Wundt (1832–1920), of the University of Leipzig, is generally considered the father of experimental psychology. He founded the first laboratory to be exclusively used for psychology (in 1879) and drew students from all over the world, among them many who have since become famous in their own right both in this country and abroad.

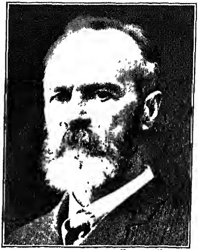
During his long life, Wundt was a prolific writer on all phases of psychology, and among the problems attacked in his laboratory was the one of reaction time. The reaction-time experimentation at Leipzig and elsewhere established the fact of the existence of individual differences and their extent in terms of the amount of time required by individuals to respond by such a simple movement as pressing a telegraph key when a light is flashed. It also discovered that the time is shorter if the subject attends to the *response* to be given than it is when he attends to the expected *stimulus*. The sensory avenues, too, were found to differ in their efficiency, the response to a visual stimulus being the quickest, followed by auditory and touch.

Variations, too, were worked out in the manner of presenting



Keystone View Co.

WILHELM WUNDT (1832–1920)
Leipzig



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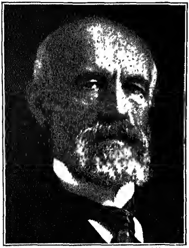
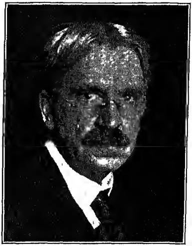
WILLIAM JAMES (1842–1910)
Harvard



Keystone View Co

G. STANLEY HALL (1846–1924)
Clark



Keystone View Co

JOHN DEWEY (1859–   )
Columbia

PIONEERS IN PSYCHOLOGY

the directions to the subject. There was the *choice reaction*, in which the subject was asked, for example, to press the left key if a green light was flashed and the right key if a red light. Reaction time in such cases was longer than in the simple reaction, and the question arose as to what processes were going on during this extra time. Wundt charted them as follows: (1) apperception of the stimulus, (2) will to react in a certain way, and (3) response.

The Wurtzburg school. Certain other psychologists, however, took exception to this formulation, among them, Külpe and others at the University of Würtzburg.[3] They repeated the experiments, and from the introspections of their subjects brought to light a very important concept for both psychology and education. They found what looked like a kind of mental and perhaps motor response called a *determining tendency*, or set, coming in before the stimulus light was flashed, really as a reaction to the directions.

Set. The phenomenon of set is a familiar one, as, for example, in the "Get set!" of the starter of a foot race. It produces a state of readiness for a certain kind of action. But set is more than a state of readiness; it is truly a determining tendency, operating throughout a series of complicated actions. It operates to keep the runners going on the track instead of making for the stands, and without their thinking anything about it. It is to be observed when a schoolboy continues to add all the "examples" when the directions to add appear only at the top of the page. The wrong set is responsible sometimes for a person's not getting the point of a joke.

The assignment. The directions of a psychological experiment correspond to the assignments of school work, in that they are aimed to create the proper set. If the assignment is properly made the pupils understand clearly what is to be done, not merely in terms of examples to be completed or pages

to be read, but in terms of the processes to be employed and ends to be achieved. The question, "What are we supposed to do?" has been anticipated by the teacher so that pupils, instead of wasting their time in vainly casting about, will be "all set to go."

3. SENSORY-MOTOR EXPERIMENTATION

In the experimental work spoken of above, the reaction called for is a simple pressing of a key when the signal is given. In sensory-motor experimentation [4] the task is longer, and the time taken to perform it instead of the time between the stimulus and the response is measured.

Tapping. The simplest of these experiments consists in measuring the number of taps a person can make in a certain period of time A stylus and electrical recording device may be used, or merely a pencil and paper. While the set remains constant, the score measures the rapidity with which separate impulses travel over the sensory-motor arc. The score varies with different individuals from six to eight taps per second, with differences due to age, fatigue, handedness, etc. The test can be varied in different ways, for example by having the subject place each dot in a small circle already printed on the test sheet.

Cancellation and symbol substitution. In the latter form the tapping experiment begins to approach the cancellation test. For this test, especially prepared blanks made up of rows of numbers or letters have been devised, but it can be performed with a page from an old magazine. The directions are to cross out all the *e*'s (or any other letter) as rapidly as possible. The score is the number of letters crossed out per minute.

More complicated still is the symbol-substitution test, the

most common form of which is the digit-symbol test. A key appears at the top of the page showing that each digit belongs with some letter or other symbol. Below the key are several rows of symbols, and the subject is asked to place next to each the digit that belongs with it.

Uses of sensory-motor tests. What are such tests for? is the question which naturally comes to mind. Here we have tasks so simple that anyone can do them the first time; though practice improves the speed of performance somewhat, the limit of improvement is soon reached.

Such tests of sensory-motor coordination are used in experiments to find out about other things; for example, to test the effect of drugs or of fatigue. If the score goes down after the drug is administered, or after a certain amount of mental or physical work, the conclusion is that the person's efficiency is reduced, and by a measurable amount. The tests are also somewhat indicative of abilities which are needed, for example, in certain kinds of clerical and industrial work.

4. AVAILABILITY OF THE RESPONSE

Multiple response. To the same stimulus situation any number of responses may be made. Man is particularly fortunate in this respect in contrast, say, with amoeba, which can only approach or back away. A dog's response to a piece of meat is to gulp it down, though he may sniff at it and refuse it. Man can do these things and more — cook it in various ways, keep it, carve it, or give or sell it to someone else.

In the same way, the stimulus presented in any of the various types of experiments discussed above, by itself is capable of calling forth any number of responses. Were it not for the directions, the subject of a reaction experiment might extinguish the light stimulus, or he might draw pictures in the circles

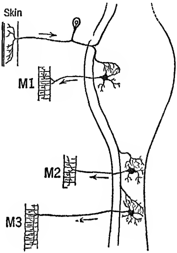


FIG. 58. DIAGRAM OF MULTIPLE RESPONSE
(After Herrick [5])

of the substitution test blanks. Multiple response, as the phenomenon is called, may be diagrammed as in Fig. 58.

This diagram on a very much more complex scale may be found in the structure of the neuro-muscular system. The axon of one spinal neuron connects with the dendrites of a number of different neurons, connecting eventually with a number of different groups of muscles. But anatomy and physiology do not explain why, in a particular situation, R_1 is made rather than R_2, except as reference is vaguely made to the "openness of the synapse."

Piecemeal activity. One explanation of multiple response is to be found in the fact that a stimulus situation is a complex thing, to which an individual may respond piecemeal, that is, to a part of it at a time. Thus the separate parts really become separate stimuli, each with at least one appropriate response of its own. The pattern of stimuli may be perceived

as an automobile, in which case one may blow the horn, put on the brakes, turn up the lights, or look under the hood.

Since a number of different responses are available for different elements in the situation, the *prepotency* of some parts over others may serve to explain the response made.

Or, the response may be by *analogy*. There is something in the situation which is familiar; and to that part, response is made in the familiar way. Analogy is a useful guide, though an untrustworthy one at times. Children learn with difficulty that they may cut white paper with their scissors but not white napkins, that they can safely pat kittens but not strange dogs, and that they may pick dandelions but not their neighbors' dahlias.

Or, again, the response may be to certain *perceived combinations of stimuli*. A child responds to a dog and a ball or to a combination of teacher, book, paper, and pencil in a way that is different from that in which he responds to one of them separately. Thus a pattern or arrangement of elements is built up, which neglects other aspects of the environment. It is another example of figure and ground.

But whatever may be the response called out by the stimulus or combinations of stimuli, in all these cases it is one which the individual already knows how to make and one he can make. It is *available*.[6] This is not the case, however, with many responses. Even though a person may know that if he falls into deep water, the thing to do is to swim; if he hasn't learned how to swim, he cannot make the right responses. The coordinations are too complicated.

5. HABIT AND SKILL

Trial-and-error learning. The coordinations needed for motor skills, whether they are vocal, or manual, or involve the

whole body as in swimming, are acquired only at the cost of much practice. Trials are repeated again and again, often without much improvement, so that the process has been called trial-and-error learning. A more optimistic name, "trial-and-success," is sometimes used, but the term trial-and-error has become too well entrenched to be easily dislodged.

The efforts of the beginner are at first *poorly coordinated.* They are awkward, as at the first meeting of a gymnasium or dancing class; and they are ineffective, as in tennis and archery. The multiple responses which are made gradually approach the correct movements, producing what is sometimes called *accidental success.* The good responses and coordinations tend to be *repeated,* the poor and useless ones gradually *eliminated,* until a certain proficiency in the skill is acquired. Continued practice is necessary to hold what has been gained, and perhaps to make the little improvements which lead to perfection in any craft or art.

The trial-and-error process of acquiring skills, that is, of developing patterns of response which were not previously available, has been investigated by many experimenters.[7] Subjects have juggled balls, learned the telegraphic language, operated typewriters, done mirror drawing, sorted cards, aimed arrows at targets, drawn four-inch lines blindfolded, and done numberless other things under controlled conditions, that the process of learning might be better understood.

The time curve. In all these experiments there are two main variables — the *time* taken and the *amount* (or quality) of work accomplished. There are therefore two common ways of measuring and recording the results. The first is by keeping the amount of work constant and recording the *time taken* for each successful completion. Thus, in the mirror-drawing experiment, in which the subject looks in a mirror at the reflection of a star which he traces on the paper before him, the

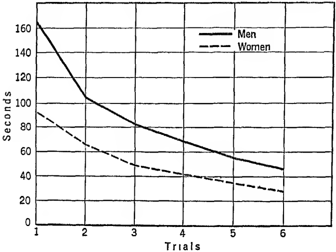


FIG. 59. IMPROVEMENT IN MIRROR DRAWING — TIME CURVE
(From Table 8 By permission of Warwick and York)

performance is measured in units of time taken to make each complete tracing. The results of one such experiment, in which the records, for a number of subjects are averaged, are shown in tabular form in Table 8 and in graphical form in Fig. 59. As the subjects improve their skill, the time curve falls, indicating that with continued practice they are doing their work in a shorter and shorter time.

TABLE 8. IMPROVEMENT AND SEX DIFFERENCES IN MIRROR DRAWING
(After Yoakum and Calfee[8]).

Sex	No.	Seconds required per trial						Avg.
		1st trial	2d trial	3d trial	4th trial	5th trial	6th trial	
Men	51	167.5	105.0	80.0	68 0	56.0	48.0	97.83
Women	52	92 0	65.0	48 0	41.0	35 0	28 0	54.70

The work curve. The second way to measure and record the results of a learning experiment is to hold the time constant and record the amount accomplished. The subject works for perhaps a minute, five-minute, or ten-minute period, and the amount accomplished is measured, so that his performance is the *amount done per unit of time.* Thus, for the substitution test, the results are shown in tabular form in Table 9 and graphically in Fig. 60. Other work curves from two of the

TABLE 9. SUBSTITUTION TEST: NUMBER OF SYMBOLS WRITTEN [9]

30-second period	1st	2d	3d	4th	5th	6th	7th	8th	Total
Average, 12 men	13 7	16 1	17 6	16.3	14.8	17 2	16.7	17 9	127.3
Average, 28 women	13 9	15 4	16 0	17.9	16.0	17 0	16 8	19.0	132.0

pioneer experiments in this field are shown in Figs. 61 and 62.

Characteristics of the learning curve. In learning of this sort, it is to be noted from the shape of the learning curve that *rapid initial progress* is usually made. But this is due to the fact that many of the skills needed are already learned. If it were necessary to start from the very beginning, progress would be slow indeed.

Then there is quite often a period of no progress in which the curve flattens out. This is called a *plateau,* and is due at least in part to the fact that a number of separate items have to be attended to.[10] While progress in each one may be fairly constant, the task of coordinating them delays improvement. In typing, for example, the location of the keys of different letters has to be learned before the words which they spell can be written; and numbers of frequently occurring letter combinations have to be learned before lines and sentences will be written automatically. Such a sequence as the learning

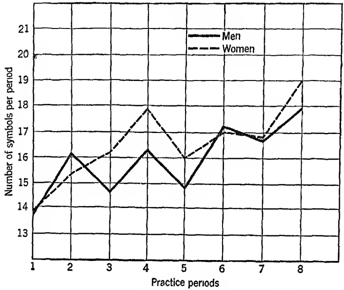


FIG. 60. IMPROVEMENT IN A SUBSTITUTION TEST — WORK CURVES
(From Table 9)

of letters, words, and sentences, called a *hierarchy of habits*,[11] is no doubt often responsible for a plateau.

Besides the plateau, there are smaller ups and downs which may cause discouragement unless their nature is realized. These are called *minor fluctuations*, and are due to a number of causes such as fatigue, slight illness, room temperature, motivation, and so on.

The curve tends to flatten down toward the upper end, indicating greater and greater perfection, and gradually approaches a *physiological limit* beyond which improvement cannot go. But an individual may cease to improve before he has reached the most rapid and perfect coordination that is humanly possible, or even before he has attained the degree

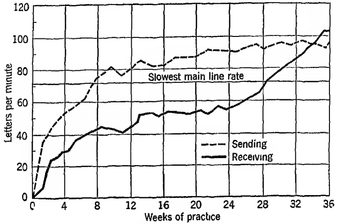


FIG. 61. IMPROVEMENT IN TELEGRAPHY[12]
Individual, E. L. B.

or skill of which he is capable. This may be because of a lack of interest on his part, or lack of practice or of proper training and instruction.

The amount of practice required at the upper end of the learning curve to obtain a certain amount of improvement is much more than is required for the same amount of gain at the lower end. For in most skills, handwriting, piano playing, or whatever they may be, anything approaching perfection is obtained only at the cost of a great deal of time and effort, more than the majority have the inclination to expend, in view of all the other things they want to do. Excellence in any skill or art, however, demands this added effort. Paderewski, the noted pianist, is reported to have said. "If I don't practice for a day, I know it; if I fail to practice for two days, the critics know it; and if I haven't practiced for three days, everybody knows it."

Sensory control. Though it is not often realized, the kines-

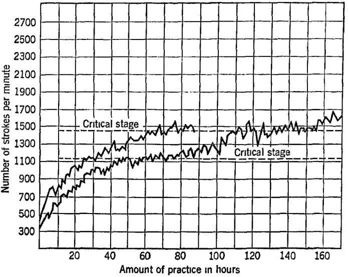


FIG. 62. IMPROVEMENT IN TYPEWRITING BY THE SIGHT METHOD [13]

thetic sense directs and controls the motor skills more than any other. But the sight and the hearing, as well as the sense of touch, are constantly used to control the bodily movements. Just when the fingers should be watched in striking a keyboard or fingering a stringed instrument is sometimes hard to say. But when things must be brought together, like a hammer and nail or a ball and bat, the eyes are quite indispensable. "Keep your eye on the ball," is heard in different sports; but the "hold," the "stance," the "swing," the "stroke" — these terms suggest a kinesthetic reference which is not less important.

Knowledge of success and error. If the trials are continued without the subject's knowing whether a performance is good or poor, he fails to make improvement. A person can try to

draw four-inch lines blindfolded; but if no one tells him whether the lines he draws are too long or too short, he fails to improve; and even the length of line he draws more frequently at first may not be continued in later trials. If, as in archery, the novice can tell whether he is hitting the bull's eye or not, he cannot tell whether he is holding the bow and arrow the right way, the way which will make for better marksmanship. When the coach says, "That's the way. Do it that way," the kinesthetic and visual control apparatus has something to go on.

These illustrations show where instruction helps in the process of acquiring a motor skill. The teacher or coach is able to see which movements are wrong and which are right when the novice can't, and by calling them to the learner's attention he can both shorten the period of trial and error and prevent the formation of incorrect motor habits.

Oral habits. The motor coordinations involved in speaking and singing are exceedingly complex. The vocal cords are two folds of tissue across the windpipe, which stretch and come close together for the higher notes, and relax somewhat for the lower ones. But this is only a part of the process. The lungs and supporting muscular diaphragm control the volume of air which is blown between the vocal cords; and the shape of the mouth, tongue, and lips varies the vowel and consonant sounds and the resonance of the overtones produced by sympathetic vibration in the nasal cavities. The sensory control is almost entirely kinesthetic and auditory. True, a person may observe himself in a mirror to see how he looks when he sings, but if this does not discourage him, it is more apt to lead to improvements in his appearance than in his singing.

The *pronunciation* of the words in the mother tongue is learned little by little during early childhood, and only those who have heard and spoken two languages during their child-

hood years are true bilinguals. If an adult tries to acquire a foreign tongue, the vocal habits earlier formed will give his speech the readily detected accent of the foreigner.

More important for the teacher, then, than to attempt to change the pronunciation of children from that which they hear constantly in their home environment, is the task of correcting *speech defects*. Hisses, whistles, lisps, and nasal sounds in one's speech, as well as stuttering and stammering, are definite handicaps which can be entirely removed or considerably lessened. And school is the natural place for this to be attended to.

An important phase of the development of vocal skills in the schools is to be found in *forensics*, including the extemporaneous contest, debating, dramatics, and the more informal assembly programs. While these, like singing, involve more complex coordinations than those of mere vocalizing, even including the overcoming of stage fright, they represent phases of the acquisition of oral skills and are coming to have a more important place than formerly in the school program.

Most schools are still backward in the development of *singing* among the pupils. This is perhaps in part a hang-over from the aristocratic tradition of private lessons for those who could afford them, and in part due to the pioneer and commercial heritage that has time for only so-called practical things. The result has been a distinct loss, particularly in a time when leisure activities are sought by those of all economic levels. It may be that the encouragement that comes to the individual with the development of his ability under proper direction will create a demand for better songs, and that the enjoyment of group singing will be rediscovered.

Manual habits. The hand, unlike the voice, can be watched as it learns, so that a rather complete visual control cooperates with the kinesthetic. Some have said that the development of

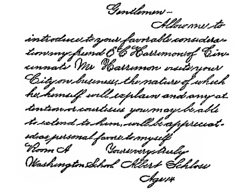
civilization is due to the sensory-motor potentialities of the human hand; or, in other words, man's mind could not have developed as it has if he had had paws. Be that is it may, the capacities for fine motor adjustment are undoubtedly reflected in the skills [14] of the workshop, the laboratory, the studio, and the study.

The *industrial arts* constitute an important phase of education on the sensory-motor level. They appear in the curriculum not necessarily for the purpose of giving vocational training, but as in the case of the "general shop," as a part of an all-around education. Studies have shown that besides developing motor skills the experience of manipulation is an aid to motivation, learning, and retention.

Progress in the *fine arts* is unfortunately so meager in the schools that one has the courage only to hope. Children have moulded clay and with finger paint and water color have produced color combinations which suggest that opportunities for artistic expression should be continued above the kindergarten-primary level, with instruction not too hurried, and with ideals not too mechanical. Many kinds of material go into the structure of an art, in which the needle and the hammer are far from being humble contributors. Perhaps the beginning should be in "arts and crafts"; and then on the part of some, at least, the demand may arise for oils and clay.

As one of the "three R's," *handwriting* has always occupied a place of prime importance in the schools, and it has probably received as much attention as any subject in the curriculum. Styles of writing come and go, as do approved methods of teaching it. At the present time controversy wages over the respective advantages of the usual cursive writing and a form of lettering called manuscript writing. The experiments seem to be equivocal in respect to the speed, ease of learning, and legibility of the two styles, though the similarity of manuscript

1876


Gentlemen -
Allow me to
introduce to your favorable considera-
tion my friend E C Harrison of Cin-
cinnati Mr Harrison visits your
City on business, the nature of which
he himself will explain and any at
tention or courtesies you may be able
to extend to him, will be appreciat-
ed as personal favors to myself
Room A Yours very truly
Washington School Albert Schloss
Age 14

1919

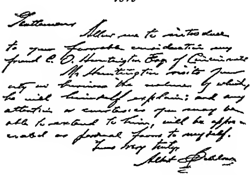

Gentlemen Allow me to introduce
to your favorable consideration my
friend C. O. Huntington Esq. of Cincinnati
Mr Huntington visits your
city on business the nature of which
he will himself explain; and any
attention or courtesies you may be
able to extend to him, will be appre-
ciated as personal favors to myself.
Yours very truly
Albert Schloss

FIG. 63. TWO SPECIMENS OF HANDWRITING OF THE SAME INDIVIDUAL

The first is from a volume of specimens prepared for the Centennial Exposition in 1876, the second in the same writer's customary hand in 1919 (After Courtis[15])

writing and print makes the earlier stages easier for the pupil.

Scales[16] have been devised to measure handwriting in terms of appearance and legibility. These scales are made up of

samples of handwriting graded from the worst to the best, with known amounts of difference between the steps, and such score values arbitrarily assigned as 10, 20, 30, and so on. The pupil's work is matched against these samples and given the score of the one it most nearly approximates.

The earlier efforts to develop handwriting that looks like steel engraving have been largely given up, partly because of the press of other subjects in the curriculum, and partly because the skill is unnecessary and slips away after the school days are over (see Fig. 63). While shorthand did not replace longhand, as was originally expected, the typewriter is finding its way more and more into the schools. It used to be the case, and still is in many places, that a child could not learn to typewrite in school unless he took a commercial course. But now many typewriters are found even in the primary grades in which children are usually first allowed to use pen and ink.

Bodily skills. Apart from forensics and dramatics, already mentioned, the motor skills involving the movement of the body as a whole are chiefly to be found in play. With the change of emphasis which has taken place in recent years from athletics to *physical education,* the task of the coach is not so much to win games as it is to teach and develop children. Group games like football and basketball with their strong appeal to mass emotion still have their place; but the sports like skating, swimming, tennis, and golf, which the individual can enjoy after he is through school, are beginning to receive the attention which is their due.

It is not the purpose of this chapter to suggest methods of teaching these or other skills, nor is it to trace in detail the processes by which the separate skills are acquired. Neither can it indicate the ways in which handicaps due to the inherited physical nature of the child or to earlier wrong methods may be overcome. It is rather to point out the importance

and the variety of activities, many of them with rich values of their own, which depend on motor skill, and to demonstrate their essential organic unity.

Summary. Motor skills are all initiated and carried on through the operation of a set, which depends in large measure on the directions that establish the goal sought and direct the ensuing activities, and also on other motivating factors previously discussed. They all carry with them the necessity of trial-and-error learning. The learning takes place through successive trials; and errors, mistakes, failures are a part of the process. They are all directed by complicated sensory controls, chiefly visual, auditory, and kinesthetic. And they all improve more rapidly under instruction, which seeks to prevent wrong coordinations from occurring, and suggests better methods at points where they are needed. And lastly, they all require repetition, that is, practice or drill, for their performance and retention.

QUESTIONS

1. How can sports, hobbies, shop, and laboratory work facilitate the learning of children in different kinds of situations?
2. In what ways may a knowledge of physiology be of value to a student of psychology?
3. Supply examples from the home or school life of children to illustrate prepotency, analogy, perceived combinations of stimuli, availability.
4. In what ways may a knowledge of the facts about the plateau and minor fluctuations be of help to the teacher?
5. In the case of some skill, show exactly where and how some instruction you have had has advanced your progress in its acquisition.
6. Should persons be allowed to teach a modern language who cannot speak it fluently and accurately? Explain.
7. What are the educational advantages of forensics, including assembly programs and dramatics, over declamations?

8. What can be done in school to develop the possibilities of music and art work?
9. Why should perfection not be the objective in teaching handwriting in the schools?
10. What motivating factors operate in forensics, shop work, typewriting, physical education?

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CHAPTER XI

THE ACQUISITION OF KNOWLEDGE

Knowledge and the curriculum. While many motor skills of practical and esthetic value are taught in the schools, the acquisition of knowledge has long been considered the major task of the pupils.

It is not an easy matter to determine what should be acquired — what knowledge is of most worth. But such new knowledge as seems worthy and useful is constantly being adapted to the intelligence levels of school children and is just as rapidly displacing many of the parts of subjects which were valuable once, but are no longer.

The process of acquisition is apt to be laborious, and none too enjoyable. Rewards, punishments, and barriers have come into play, as has been indicated, as well as methods of classifying pupils, schemes for individualizing instruction, and methods of teaching — Herbartian, problem, project, activity, and others. All, however, are in the last analysis dependent upon the nature of the human mind.

I. ASSOCIATION

The association experiment. Many kinds of simplified situations have been presented to subjects to determine what it is that makes a person think of what he does think of, and to describe and classify the responses he makes to the different kinds of stimuli presented. One of these is the *free association* method. The term is used in three different ways. The first applies to the continuous, uncontrolled association technique

employed by the psychoanalysts when they have their patients discuss their troubles and their dreams and relate them to their past life, allowing one thing to lead freely to another with little direction given by the psychoanalyst as to what they talk about.

A second use, a variation of the first, involves a certain amount of control in that the subject is asked to write or pronounce separate words as rapidly as he can think of them, but not in the form of sentences. Ten-year-old children are normally expected to say sixty words in three minutes, according to the Stanford-Binet intelligence test. They can write only thirty words in three minutes on the average, while college students write about forty-five or fifty words. The words that subjects thus recite are indicative of their familiar experiences and sometimes of their desires.

The third way in which the term "free association" is used involves still more control. The experimenter pronounces a single word, or exposes it to the subject's view, and the subject is asked to respond as quickly as possible with the first word that it suggests to him. Then another word is presented, and so on, the procedure being that of the reaction-time experiment, the response words and the reaction time for each response are recorded by the experimenter. This discrete method of presentation allows a study to be made of the nature of association the subject has made for each word in the list so presented to him.

In this form the free association test has been recommended for the detection of crime.[1] In the list of stimulus words are inserted some which apply to the crime being investigated, and which refer to certain matters which only the criminal could know. The total list is then presented to the suspects individually. The guilty one, then, in response to the key words, will be expected to say something which will give him away.

Or he will discern the trap and respond with an unrelated word. But this will catch him too, for his reaction time will be longer while he is thinking of another word, and the presence of unrelated responses is a matter of suspicion.

Unfortunately, the method wouldn't work very well on the witness stand, chiefly because everybody knows almost as much about the crime as the criminal himself; and the innocent are apt to be so afraid of seeming guilty when faced with the suspicious-looking words that they would respond nervously in the same way.

The free association test has been used successfully, however, in a number of different ways. Psychologists have used it occasionally for the detection of a youthful impostor, since the intellectual and emotional background, the apperceptive mass, it reveals is that of his true past instead of his pretended one. Some psychoanalysts[2] have used it to reveal the repressed thinking of their patients. And it has been employed in experimental studies of emotional responses, often in conjunction with the psychogalvanometer,[3] when such words as "kiss," "love," etc., are included among the stimuli.

Logical relationships. A good deal of work has been done to determine the frequency of responses to common words.[4] For example, to the word "table," the response is much more likely to be "chair" than it is "leg," "of," or "and." This is peculiar, because the word "chair" never follows "table" directly: One says "table leg," but never "table chair," though "table *and* chair" is common enough and "table *of* contents." Furthermore, the words "dining-room" and "multiplication" often directly precede the word "table," but they are rare responses indeed; or, to take another example, to the word "day," "time" would be a more frequent response than "winter."

It is to be noted, then, that logical connections are more apt

to appear than verbal sequences.[5] And when the latter are found, the word which normally follows is given instead of the word which, in ordinary usage, precedes.

The logical sequences themselves have been analyzed in considerable detail. The following are quite common; examples are given of each:

Classification	*Stimulus*	*Response*
synonym	fast	quick
antonym	day	night
modifier	house	stone
rhyme	hill	bill
part-whole	tree	branch
subordination	animal	dog
supraordination	pike	fish
cause-and-effect	fight	kill

In the case of the *controlled association* test the experimenter states one of these logical relationships and then pronounces the stimulus word. He would say, for example: "Give the *opposite* of the following words: 'night'... 'winter'... 'inside,'"... and so on. Thus the mental set of the subject is created, and hence the response to the stimulus word is controlled. The controlled association test is thus an exercise in the "eduction of correlates"[6] mentioned earlier. The reaction time is longer, but in this form the test more nearly resembles the usual demands on one's store of knowledge than the free association test. The teacher asks the pupils to give "the sum of six and eight" or "the past tense of swim." The "first word that comes to mind" might have little or nothing to do with the case. In the practical affairs of everyday life, one is compelled to meet such situations for which the schools have supposedly prepared him to respond correctly and in many cases automatically.

The laws of association. In all of these cases of association,

however, it appears that the stimulus and response words, or what they stand for, have been experienced together. When there has been no training, the natural arrangement of things in the environment is responsible, for where there are trees there are branches, and nothing follows more surely than the night the day. By the process of learning, countless experiences are brought together, somewhat artificially sometimes, perhaps, and repeated again and again until the correct response has a reasonable chance of appearing.

Experiences which are present together are called *contiguous*, and *contiguity* is the basic law of association. Contiguous experiences may be of different kinds. They may be contiguous in *space* like the tree and the branch, or in *time* (succession) like day and night. Or they may be thought of together because of their *similarity*, like "fast" and "quick," or because of a *contrast* in otherwise similar objects or events, like "fast" and "slow."

The laws of association — similarity, contrast, contiguity in space, and contiguity in time (or succession) — have been worked over and modified from time to time. For example, *frequency* has been added, since many associations must occur more than once to be permanent. However, under emotional strain or the excitement of a vivid experience, no repetition is necessary for recall. Hence, *intensity* has likewise been added to the laws of association. Frequency and intensity, however, are not so much laws of association as they are conditions which affect the operation of association by contiguity.

What is called a "school" of psychology, the associationist school,[7] has made these principles basic ones in their interpretation of the nature of the mind. And they are used very frequently by the man in the street when he brings himself to psychologize about his own mental processes. "How did

I happen to think of that?" he asks himself. But when he discovers a chain of associations, when he has traced the thoughts that have gone, he still doesn't know what he *will* think or what he will *do*.

2. CONDITIONING

Associative shifting. If a boy wants to train his dog not to jump up on people, he steps lightly on its hind feet when it does jump up, and says, "Down." After a number of such experiences, the dog drops on all fours when the verbal signal alone is given. He has thus shifted the response to a new stimulus which previously had no effect whatever.

We can say that the dog comes to "associate" jumping up on people with having its toes stepped on, and the word "down" with a similar contiguous experience without unpleasantness. Perhaps it does, but it cannot introspect and tell us what its ideas are, or even whether it has any or not. To ascribe qualities of human beings to lower animals is called anthropomorphism. The resulting explanation may be the correct one [8] and shouldn't be discarded entirely; but there may be a simpler one that is in agreement with the facts, and not based on the anthropomorphic assumption.

In the illustration given, the dog behaves as if it did associate the idea of jumping up on people with getting its toes stepped on. But perhaps it behaves that way without ideas. At any rate, it can be trained to keep from jumping up on people, to come, lie down — in fact to *do anything it is capable of doing when any signal is given to which it is able to respond.* This is the important fact.

The conditional reflex.[9] In the human body, behavior is called *voluntary* if it is subject to conscious control, that is, if the person can do a thing, or not, whenever he wishes.

Involuntary behavior, on the other hand, is automatic, like the heart beat and the processes of digestion. One of the involuntary reactions is the salivary reflex. The salivary glands secrete their fluid upon the introduction of food into the mouth, but a person cannot voluntarily produce this secretion in desired amounts If a process like associative shifting can be made to operate in the case of an involuntary response, the principle of association reveals itself as applicable not only to ideas, and to voluntary behavior, but to innate physiological responses as well.

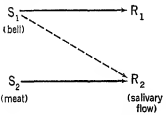

FIG. 64. THE CONDITIONAL REFLEX

Extensive experiments on the salivary reflex of the dog have been performed by I. P. Pavlov (1849–1936) and his associates at Leningrad Pavlov won the Nobel Prize in 1906 for his researches on the activity of the digestive glands, and this physiological experimentation led to the work on the salivary reflex.

The basic plan of Pavlov's reflex experiment is perhaps best illustrated by the oft-repeated dog-and-bell set-up. If a dog hears a bell ring, there is no salivary response; but if he is allowed to taste meat, the original *un*conditional salivary reflex is elicited. If the bell and the meat stimuli are presented simultaneously, there is a salivary response owing to the presence of the meat. After the bell and the meat have been presented *simultaneously, a number of times*, the bell stimulus *alone* will thereafter produce the salivary response — the conditional reflex (see Fig. 64).

Does the dog "learn to associate" the meat and the bell? Again, perhaps. At least that is one way of saying it; and certainly the cerebral cortex is involved. But even in the case

of a man, to say nothing of a dog, we are going a little too far if we say that the bell made him think of the meat, so he decided that he would secrete a little saliva to be ready for it when it came! The process is apparently a little more mechanical than that.

The conditional reflex experimentation has continued over a number of years and has added greatly to our knowledge of the learning process. Numberless variations have been tried — different kinds of stimuli, visual, tactual, etc.; different intervals of time between the otherwise simultaneously presented stimuli, and between later trials, to get the lasting effect of conditioning; stimuli which inhibit the salivary reflex instead of rousing it; and conflicting stimuli which the dog has been conditioned to respond to in opposite ways; as well as the conditioning of other reflexes, and of the reflexes of other animals including man.

Conditioning and behaviorism. But since we are concerned with dogs and their salivation only as they reveal basic psychological laws, let us see what some of the applications are in the field of human learning.

Practically every native reflex of the human body has been conditioned by the Pavlovian technique — withdrawal of the hand to pain, the winking reflex, even the iris reflex, and many others.[10] The methods and results are the same for human beings as for dogs. In both, the repeated simultaneous presentation of the original with the new stimulus has resulted in the latter's becoming a *substitute stimulus*; or, to put it the other way around, a *substitute response* has been made to a stimulus which did not formerly elicit it.

The behaviorists, formerly a very prominent school of American psychologists under the leadership of John B. Watson, sought to explain all human life, including thought and emotion, in terms of behavior. To get rid of the difficulty the

study of ideas presented, they defined thinking as "sub-vocal talking," maintaining that thought is merely a symbolic form of vocal response.

It was very fortunate for the behaviorists that Pavlov's concept of conditioning had already appeared. From their point of view it could now be contended that children's responses, mental as well as physical, can be conditioned, and a hierarchy of behavior habits developed, a continuous reconditioning of previously conditioned reflexes, which could be counted on to work out in a more or less carefully prescribed fashion.[11] The behaviorists' enthusiasm, like that of many others, has not been without its advantages. Experimentation became more definite and less dependent on somewhat tenuous introspective reports. And the work in child psychology, in particular, profited from the new emphasis. For like comparative psychology, it cannot depend on introspections and hence must put its faith in the observed responses of its subjects.

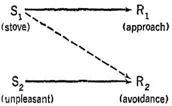

Fig. 65. The Process of Conditioning Behavior

Conditioning and education. The conditioning technique found its most useful application in the realm of emotion, for the emotional responses such as those of fear and anger, whatever else they may be, are very obviously behavior of an involuntary sort. How fortunate if they could be handled as systematically as the involuntary salivary reflexes! And such proved to be the case.

Suppose it is desired to condition a child to respond negatively to a stove. It is the withdrawing response that is desired. So if an unpleasant stimulus when he approaches the stove produces this response, the stove alone will produce it

if the two stimuli are presented simultaneously a sufficient number of times (see Fig. 65).

In this illustration one comes around to the familiar mechanism of associative shifting which really did not need any salivation experiments, seemingly, to demonstrate its validity. But the experimentation has helped in two very definite ways. First, a person who understands the process will not be disappointed or exasperated if the treatment when once administered does not act permanently, once and for all. Secondly, he will realize that a number of factors which are under control in an experiment are not under control in a life situation — the time, the intensity of the stimuli, other persons present, and so on. Besides, he will know that indiscriminate punishment, unconnected with the behavior situation desired, makes for confusion, and is a waste of energy.

The conditioning process may be continued so that the words "No, no" or "Don't touch" serve as substitute stimuli for stoves and other objects harmful to small children. And this suggests that another element in the process be emphasized. The stimulus to which the animal is to learn to respond is always the same one. This applies to verbal stimuli as well. Better results are therefore obtained if the same verbal formula is always used in a particular situation. If a child has learned to back away when his mother says, "Don't touch," he will probably be at a loss when his father says, "Get away from there!" The same words with the same inflection for the same desired response are far less confusing than an extensive vocabulary. In the latter case, especially if adult emotion is mixed into the stimulus situation, the child may become conditioned to some of the emotional aspects, so that the adult in reality loses control.

Just one more illustration of conditioning, this time in the realm of emotion. If a child is afraid of a dog, an original

stimulus for a positive reaction of emotional satisfaction and pleasure should be presented a number of times simultaneously with the dog. Such a stimulus might be food, candy, or enjoyable play with other children (see Fig. 66).

The intensity of the dog stimulus should be regulated by keeping the dog at a sufficient distance so that, in the presence of both, the positive reaction occurs. Otherwise the conditioning would work the other way around, and the child would show negative emotional responses to the food or candy, or to the other children.

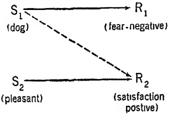

FIG. 66. EMOTIONAL CONDITIONING

This is what often happens in the case of the so-called feeding problems of children who "won't eat." To a natural dislike for a certain food is added repeated parental scolding and punishment, with the result that the dislike for the latter is shifted to other food and to the whole meal-time situation. Such negative conditioning is too often found in homes and schoolrooms, where a more scientific attitude should prevail. The more effective method requires patience, but its success is its own ample reward.

3. RETENTION

Memory. When anything is once learned, whether it is a sensory motor skill that is acquired, a passage of poetry or prose that is memorized, or facts and ideas that we call knowledge, what happens then? The kind of mind one sometimes wishes for would retain these things as perfectly as a phonograph record, and would be able to reproduce them on call. But for all people, though in various degrees, time has a

devastating effect on what was once known. Rapidly at first and then more slowly the items once learned fold their tents like the Arabs and silently steal away.

Memory span. A number of devices have been worked out which have furnished considerable information about the process of forgetting, and the results have important implications for teaching. The immediate memory for serial impressions [12] can be tested by presenting orally a list of digits or words at intervals of one second, to see how many the subject can repeat correctly. The Stanford-Binet intelligence examination requires a memory for five digits at the seven-year mental level, six at ten years, seven at fourteen years, and eight at eighteen years.

A more complex variation of the memory-span experiment is to be found in the studies of the fidelity of report. It is called the *Aussage* [13] method, according to which a number of objects are exposed to the subject's view or a series of events are observed, followed by detailed questions about them in the manner of the examination of a witness at a trial. Experimentation by this method has revealed something of the unreliability of eye-witnesses.

A simplified form of this experiment is sometimes enjoyed as a pastime and has been called "Kim's game," in honor of Kipling's immortal character who became so adept at it. A number of objects in a store window or on a tray are observed by the group for one minute. Then each one writes down as many as he can remember. If it is done as a game, the prize goes to the one who can remember the largest number of items.

The curve of forgetting. There are several different ways of measuring the amount retained — or the amount forgotten — after a *longer interval* of time has elapsed. For memoriter learning, in which the exact words are called for, the simplest way to measure retention, though not the most accurate, after

a specified interval of time has elapsed, is for the subject to start repeating what he has memorized and go on until he gets stuck. When he cannot remember what comes next, the experimenter prompts him, which he does as often as necessary. Hence, this is called the *prompting method*. The amount retained is thus measured by the number of promptings: the more that is forgotten, the more promptings.

Relearning time. A more exact method of measuring the amount retained after varying intervals of time was devised by a German psychologist, Hermann Ebbinghaus (1850–1909), who performed the pioneer experiments in the field of memory and first drew the curve of forgetting.[14] Ebbinghaus worked on the theory that the best indicator of the amount forgotten is the length of time taken to relearn. For example, if it takes half as long to relearn something as it did to learn it the first time, more of it has been forgotten than as if it had taken only a quarter as long to relearn it.

It is clear that if this technique is used, a very rigid learning method must be followed and the same one adhered to during the process of relearning. Otherwise, other factors or variables would enter in to destroy the value of the results.

Nonsense syllables. To guard against using passages of varying difficulty and having varying degrees of familiarity, Ebbinghaus first used nonsense syllables, little three-letter combinations made up of two consonants with a vowel between them, like zub, dop, faj, etc. A list of ten of these is very like a list of any other ten — there are few if any associations to aid recall; and since Ebbinghaus experimented only on himself, the conditions of the experiment remained very nearly constant.

He considered a list learned when he could make two consecutive correct repetitions. By relearning different lists after varying intervals of time he was able to describe the rate

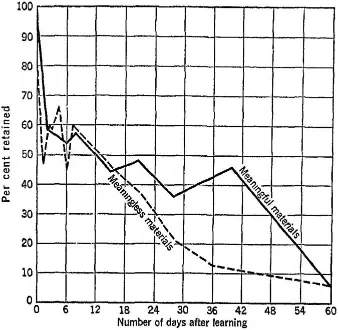

FIG. 67. CURVES OF FORGETTING

of forgetting rather accurately, at least so far as it was operative in practically meaningless material. Fig. 67 gives a comparison of his results with those of other experimenters. While there is considerable difference in the curves, they all show a very rapid loss during the first part of the time, and this becomes more gradual until a fairly constant level is maintained.

Overlearning. A further discovery of Ebbinghaus was that if a list of nonsense syllables is repeated over and over *after* it has been learned, the amount retained over a given period of time is much greater than when it is merely brought to the

point of accurate repetition. This conclusion has been verified again and again with other materials and is of great pedagogical significance. If it is desired to retain passages of prose or verse, definitions, verb forms, theorems, principles, or scientific laws for any length of time, it is necessary to *overlearn* them by repeating them after they have been learned. Only thus can the rapid initial forgetting be overcome. Later relearning — in educational language, reviewing — is likewise more rapid and hence more efficient, particularly if the time at one's disposal is limited.

Distributed repetitions. Still another contribution of Ebbinghaus is the demonstration of the effectiveness of distributed repetitions. He found, for example, that thirty-eight repetitions distributed over a period of three days was just as effective as sixty-eight repetitions made all in one day. Similarly, with other materials than nonsense syllables, one learns more efficiently by allowing intervals of time to elapse between practice than by continuous labor.

It can readily be seen that shorter practice periods of ten minutes to half an hour would be effective in tasks like mirror drawing, typewriting, or memorizing words, while longer periods of work would be more effective in more diversified tasks like memorizing poetry or prose, or in studying a history lesson. Then, too, children require shorter periods of practice than do adults. Unfortunately, therefore, owing to the differences in individuals and in the tasks, no very exact conclusions have been forthcoming which can be applied specifically in different situations. Later studies, however, have tended to confirm Ebbinghaus's original conclusion that more effective learning takes place under conditions of distributed practice than in the same length of time if the learning is massed.

Interval. The spacing of repetitions presents another problem for which there can be no answer to apply to all cases,

The optimum length of interval between learning periods and also between relearning periods (reviews) is indeterminate because differences between individuals, kinds of tasks, motivation, and so on introduce so many variables.

If, however, the interval becomes too long, a large part of each review has to be spent in getting back to the stage of proficiency reached at the close of the preceding one. If the interval is too short, the evil effects of massing repetitions, fatigue factors, and inhibitions enter in to make learning less effective. Briefly stated, *intervals between practice aid learning, though too long intervals result in loss.* How long the interval shall be must be determined by each individual in connection with the different kinds of work he has to do, or by the teacher in terms of the age and abilities of the pupils.

Whole vs. *part learning.* Attention has also been given to the question whether it is better to memorize a part, say a stanza at a time before going on to the next, or whether it is better to work through the whole selection each time.

Without going into the details of this experimentation, it will suffice to say that the results usually favor the whole method if particular attention, with a few extra repetitions, is given to the troublesome parts. One advantage of the whole method is that it connects the end of one stanza or paragraph with the beginning of the next, as it should be connected; while the part method, owing to the drilling over and over of one stanza, connects the end of it with its own beginning. So when it is desired to repeat the whole selection, the person reciting sometimes finds himself going over the same part again.

Individuation. This advantage of the whole method is really only a special case of the main reason for its superiority as a learning technique. The use of the whole method in memorizing is an application of a fundamental principle of

maturation called individuation. It has been found,[15] for example, that the development of movement in unborn salamanders does not proceed by a process of integration, that is, of putting together preformed unit reflexes into larger movements. Instead, the larger movements develop gradually and the separate reflexes grow up as parts of the larger movements.

Similarly, a person in learning to swim does not perfect an armstroke, then a leg kick, then breathing, and so on, and finally put them together, so much as he develops each gradually as parts of the total swimming activity. A child in building a tower of blocks does not build units or sections and put those together; instead he builds the tower, and the unit constructions develop in the process of the total construction.

In the same way, memorizing takes place more naturally as a whole process, the parts building themselves up, becoming individualized, as the whole passage is learned. Whether the passage is prose or poetry, music or acting, and whatever the specific method may be — reading over, visualizing, or recall — the parts take their place as *parts*, not as separate units. And as parts they are learned in the process of learning the whole.

Rote learning. Less memorizing is required in the schools now than formerly, a trend which is to be noticed in the development of other peoples. In the early Greek civilization the boys memorized the Homeric poems; in the early Roman, the Twelve Tables of the law. The Chinese boys once memorized the books of Confucius, and early American children parts of the Bible and various patriotic utterances.

But as the course of civilization widens and becomes more complex the materials for a curriculum become more extensive, so that little time is left for verbatim memorization. In a way this is unfortunate, for many wise sayings, and poems,

and songs of merit are a solace or a delight as the years go on. Too often, however, the selections which have an appeal to the adult mind mean nothing to children, and learning them is so much drudgery, which the early cultures enforced with the rod. The schoolboy's lot was not a happy one, in the "good old days," and it can hardly be said that the stern discipline of the earlier period was particularly successful in building the best of all possible worlds.

The former practice lost considerable support, too, when it was discovered that adults could memorize just about as rapidly as children and retain as well. The "golden age of memory" proved to be a myth.

Verbal memory and the school subjects. But with the passing of the "committing to memory" phase of education, the need for accurate, verbatim recall did not disappear. Children have to learn other things by heart.

Direct instruction in *spelling* usually ceases with the completion of the elementary school years, but the task of learning to spell, like woman's work in the proverb, is never done. Emphasis is now placed upon requiring the child to learn to spell the words in his own vocabulary, and also the most commonly used words, with drill on the ones he can't spell, instead of an indiscriminate going over of the ones he can and of those he never would use if he could spell them. Spelling lists are graded, and samplings are made for testing [16] pupil abilities at different grade levels.

Arithmetical computation requires memorizing brought to a high degree of automatization. Like spelling, arithmetic, with its various number combinations in addition, subtraction, multiplication and division, is a *tool subject*, that is, a group of facts to be learned which are valuable only as they are used in other connections and for other purposes.

The older method of instruction by drilling the "tables"

has therefore been found to be less satisfactory than drill on the number combinations in random order. Just as drill on the alphabet frontwards is no guarantee of one's ability to say it backwards, so drill on the multiplication table proved to be a poor way to teach children to multiply. Oftentimes children so trained have to begin at the beginning of the table or near it and work up to the particular combination they want.

Experiments in which groups of children have been taught the tables and number combinations and then tested[17] have established the truth of the principle which experience had already surmised. The principle is that *to be effective things must be learned in the form in which they are to be used.*

This principle has had a most devastating effect on the teaching of *grammar*, an effect deplored by many teachers of foreign languages, and perhaps rightly so, for the movement seems to have gone so far that many children are introduced to an inflected language without any knowledge of grammatical forms. Impetus was given to the movement by the realization that children might be able to recite grammatical rules and paradigms which it never occurred to them to apply in their speech. They could say, "Nominative, I; possessive, my or mine; objective, me," and then say, "Him and me was to the ball game." It seemed that the chief purpose of grammar was to help usage, and when it didn't do that, it should go.

Perhaps the educational conflict arose, as so often happens, from the implied assumption that all children should be treated alike. It is possible, however, that those who will never go beyond the eighth grade might spend their time more profitably than by trying to master the intricacies of grammar; while those who will go on through high school and perhaps to college could wisely be taught the idea of the nominative and

the objective, for example, and learn the grammatical names for them, so that when they come to labor with an inflected language which they have not been brought up on, their learning will be more rapid and more intelligent.

Foreign languages present the greatest difficulty to pupils, however, in the *vocabulary* which has to be mastered. And both vocabulary and usage are aided by learning the material in the form in which it is to be used. In language instruction this is referred to as the direct method. The effort is made to have the children learn words and phrases by hearing and using them as they do their native tongue. This demands a greater facility in speaking a foreign language than most teachers possess, unfortunately, which may be one reason for its meager acceptance. The children can say "*Avez vous un crayon?*" or "*Bitte geben Sie mir das Buch*" (rarely the correct "*gib mir*" for children!), but they soon tire of this kind of talk, and the time is thereafter spent on translation.

The current practice insists on a combination of the direct method and good old-fashioned drilling if progress is to be made during the few hours the school has at its disposal. The point is, however, that the learner should see where his drill fits in, and put the parts back in place when he has them by heart. No harm in learning the list of prepositions which govern the dative, but it is better to practice on an assorted supply of prepositions to see if dative, accusative, or genitive can be correctly connected with each, and better still to practice using each preposition with a number of different word combinations correctly inflected.

But *English vocabulary*, too, has to be mastered. Foreign language teachers contend that this is aided materially by the study of a foreign language. Apart from a little special pleading, it may be that they are right, chiefly because so little attention is given to the matter in English classes. It is easy,

they argue, for a child to say or write whatever comes into his mind and be credited with a good recitation on the basis of his enthusiasm or loquacity, and have no questions raised about the best choice of words to convey an exact meaning.

Should he use "unless" or "although"? Has he a command of such phrases as "by means of," "by virtue of," "consonant with," and "in spite of," or does he say "because of" or "in connection with" for all of them? If he describes a historic character, is he limited to the word "great," or can he use "far-seeing," "energetic," "commanding," "dominating," "aggressive," "conciliatory," and "wise" appropriately? Or, in a story he is writing, does the boy have to "go" across the street, or can he run, shamble, saunter, slip, dash, shoot, hurry, scamper, limp, hobble, or dodge, as the occasion demands?

Besides words in common use there are the *technical vocabularies* in any subject, which require more attention than they usually get. After a poor teacher has taught a subject a few times, he seems to assume that the children in his classes already know the words he learned the first time he taught it. Hence, such words as "modifier," "complementary," "adjacent," "commensurate," "compromise," "phylum," "dynasty," and a host of others are mere sound and fury to the poor neophyte.

In recent years a number of standardized scales [18] for both foreign languages and English have been devised, which should enable the teacher to check on the success of his instruction.

4. IDEATIONAL MEMORY

Memory for ideas. In spite of the large amount of verbatim learning required in pursuing the school subjects, much that is recalled can just as well and perhaps better be given in other

words than those in which it is learned. "Tell in your own words" is the usual formula for calling forth such ideas.

The ability to recall ideas is measured fairly accurately by reading to the subject a paragraph which has previously been arbitrarily marked off into separate units or "ideas," and tried out on a sufficient number of cases to provide scores for comparison. Such a paragraph appears in "The Story of the Fire," a test for year ten on the Stanford-Binet intelligence examination In the case of this and other such paragraphs, the object is not necessarily to repeat the paragraph verbatim, but to see how many of the ideas therein contained can be reported.

The usual school method, however, is to give a test. This may be done experimentally, however, using short-answer examinations thus assuring greater objectivity. Such a test may be given on a unit of work immediately on its completion, and then a week later, perhaps, and then six months and a year later. The test has to be carefully constructed with provision for a large number of questions, so that all the important facts (or a representative sample of them) are covered.

It has been found that when the average score obtained by students at the end of college courses in different subjects is between 65 and 75 per cent of the total possible score, on the tests given a month later the average score drops to between 35 and 50 per cent, after two months to from 30 to 45 per cent, and after sixteen months to from 20 to 35 per cent (see Fig. 67).

Since the students who are available for taking the tests over again are usually the ones in the more advanced courses in the same subjects, and since they have the practice in thus repeating the same test, these percentages are undoubtedly high. But the incidental learning of ordinary experience

enables students who have not taken the course at all to average about 15 per cent of the total possible score. So it is readily seen that the factual material is forgotten with great rapidity and thoroughness. General concepts and points of view, however, may be retained much longer.

Ideational memory and the school subjects. The *social studies* — history, geography, political science, sociology, and economics — afford wide opportunity for ideational learning. True, spelling, technical vocabularies, and so on enter in; and the ability to think and form judgments within the field being studied is of prime importance. Still, the orderly array of assembled facts must in some measure be acquired. The same is true of the *natural sciences* — geology, astronomy, physics, chemistry, and biology; but with both, a further caution should be inserted.

The now familiar principle that learning should take place in the form in which it is to be used appears again. When it is used with the experience of the child as a starting point, and with as much actual contact with things (in addition to words and outlines) as possible, it is referred to as the *psychological approach* as contrasted with the *logical*. Science is logical. It classifies and arranges facts in an orderly array. Scientific knowledge is an encyclopedia, a card catalog; its data are classified under heads and subheads with little tabs on everything so that you know the proper relationships between them, and you can find them at once.

There is a natural temptation to present facts to children in this orderly, systematic sequence, thus allowing them to benefit from the work of those who have gone before. But systematization is an end product, and the children are beginning. If they are truly to profit by those who have gone before, they must be given some of the experiences others have had in collecting these facts. They must see the details from

which generalizations are made and be allowed to follow their implications to a generalization, instead of being forced to memorize the words of the generalization without any true understanding of what they mean.

If a subject is presented "logically," the definitions come first, pages of them, "for how can a child understand a subject if he doesn't know what the words mean!" A definition, however, is made up only of words, and the glib parroting of these words is no evidence that the child knows their meaning. First he must have experience with the things for which they stand — sensory experience, visual, auditory, and kinesthetic — and a chance to do his own thinking in regard to them. Then the definition is for him what it is for the scientist, a pigeonhole, setting off certain phenomena with which he is acquainted, from other things. It must therefore come toward the end instead of at the beginning.

The presentation of the data first is the essential feature of what is called the inductive method or the *inductive approach*. A long campaign has been waged to establish it in educational practice, a campaign in which a number of straggling engagements are still going on. The history of education tells the story of scientific realism entering the schools and gradually replacing scholastic verbalism. It tells of the first picture book, of the gradual establishment of laboratories where pupils could see and work with what they were studying about. During the past two decades the books and laboratories have been improved, and shop work and various so-called activities have been added to the curriculum.

But many schools are very backward in this respect. One teacher in the Appalachians, with the aid of a map and a diagram on the blackboard was trying to teach the children what a watershed is, when on that same rainy afternoon a half a dozen of them could be seen outside the schoolroom windows.

Another teacher in the third grade of a village school some years ago was teaching "observation lessons," one of which was on the hen. A series of sentences on the blackboard was supposed to describe the hen's salient characteristics; but neither teacher nor pupils thought of looking over the fence into the hen yard next door to observe the hen in person.

Provision is made for broader perceptual experiences as before mentioned, in the course of which children visit poultry farms, bakeshops, police and fire stations, garages, factories, and so on, to learn about things at first hand. Then they go back to their books to learn more, for they know better what it is they are reading about. High-school pupils read about music, but they also hear it and play an instrument in the orchestra or perhaps sing in the school chorus. They can diagram the action of an internal combustion engine, but they can also take an automobile apart and put it together again. They not only read about trays and ornaments, but themselves hammer them out of pewter, brass, and silver.

In some engineering colleges the boys spend part of the year in industry that their "theory" may not be too widely divorced from "practice." Laboratory theaters actually stage plays to apply what the students learn of stagecraft. Medical schools require an interneship of practice under guidance, and other professional schools are following their example.

In nature and industry the campaign has been successful, and only the details remain to be worked out. In the realm of social living and political experience, many schools are still a century behind — trying to teach citizenship by words and definitions only, and in politics leaving the children to shift for themselves.

Summary. Knowledge is acquired through contiguous experiences. On the ideational level the process is association; on the general behavior level, associative shifting; and on the

reflex level, conditioning. Except for the more intense experiences, repetition is necessary for responses to become fixed, and in any case the process of forgetting becomes operative — rapidly at first and then more gradually over a period of time.

Experiments in the learning of verbal materials have shown that in verbatim memory, when motivation and other individual factors are constant, certain conditions influence the permanence of retention. Among these factors are overlearning, the distribution of repetitions (learning periods and reviews), and whole (versus part) learning. The importance of memoriter learning as well as ideational memory is recognized in all school subjects.

QUESTIONS

1. One sometimes hears the expression, "mere knowledge," or "mere facts," spoken with a note of disparagement, often in regard to some kinds of examinations Can you account for this, as well as for the attitude of enthusiasm for a member of any one of the professions who is said to "know his stuff"?
2. What subject matter did you study in high school that you consider a waste of time? What would you have liked to learn about if there had been the opportunity?
3. Without haste, allow a succession of ten or fifteen words to pass through your mind, letting each one suggest the next. Begin with the word "river." Can you explain the associations in terms of your experiences? In terms of the laws of association?
4. Compare the advantages of the use of the terms "conditioning," "association of ideas," "associative shifting."
5. Describe some home or schoolroom situation which might have been improved if the adults concerned had understood the process of conditioning behavior.
6. What are the advantages and dangers of teaching grammar?
7. Should pupils memorize propositions in geometry? demonstrations? Why?

8. What are the possibilities, in the subject or grade you are planning to teach, for giving children actual contact with the things about which they are to learn?
9. State in your own words and illustrate each of the principles of learning discussed in this chapter.

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17. See the following for arithmetic: Compass Diagnostic Test; Compass Survey Tests in Arithmetic, Wisconsin Inventory Tests in Arithmetic; Woody-McCall Mixed Fundamentals. For Algebra: Columbia Research Bureau Algebra Tests; Iowa Algebra Aptitude Test; Iowa Unit-Achievement Test in First Year Algebra. The above relate primarily to the fundamental processes.

General principles of associative learning including memory and conditioning are cited in chaps. XIII and XIV of the *Readings in Psychology*, and in chaps. V, VI, and VIII of the *Readings in Educational Psychology*.

CHAPTER XII

INSIGHT AND THINKING

Learning and problem-solving. The process of learning as thus far discussed has taken no account of reflective thinking or problem-solving. An individual may be faced with a situation which he has previously learned to meet, like multiplying 5 and 9, telling the time, giving the French word for "horse," or the definition of a triangle. His learning was a process of association — of connection-forming or pattern-making, in which contiguity, repetition, reward, and other principles were operating. In learning such things one does not figure out the appropriate responses for himself; he finds out what they are from book or teacher and remembers them, more or less effectively. The things so learned become numbered among one's available responses.

1. MEETING DIFFICULTIES

The problem situation. It frequently happens, however, that one is faced with a situation for which none of the available responses is appropriate. When tried at a venture they don't work. A hen walks back and forth behind a fence vainly poking her head through the same crevices over and over again. If a child espies a cooky tin on a shelf out of reach above his head, he may call for help, jump up and down, cry in rage, or climb on a chair to get his reward.

The problem situation is a familiar experience to everyone. To childhood, such problems as how to get another piece of candy, or how to coax a Christmas present from Dad, or how to do the arithmetic examples, are common enough; for older

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Vienna, Psychoanalysis

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IVAN P PAVLOV (1849–1936)
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Columbia, Connectionism

WOLFGANG KOHLER (1887–)
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boys and girls, how to win parental consent for another party, how to get more spending money, how to make a team or avoid hurting someone's feelings, or how to work an "original" in geometry, or translate a difficult passage in a foreign language. For young people, problems of vocational and marital choice are perhaps preponderant, though countless minor difficulties present themselves in the course of the day or week.

Wise and foolish ways of meeting difficulties or problems have already been discussed at length, and their relation to life adjustment indicated. Furthermore, individual differences in intelligence, knowledge, and skill have been shown to have an important bearing upon the effectiveness of people when confronted with a problem situation.

Prepotency and analogy. Since by its nature a problem situation is complex, and is made up of a number of different parts, it is natural that the individual should respond to those elements in it which for one reason or another are *prepotent.* But the original or learned response to a prepotent element may or may not offer a solution. Oiling a machine will not mend a broken part, and scolding a noisy child will not produce an atmosphere of study.

It is natural, too, in a new situation to respond to elements which are *analogous* to parts of familiar situations. A response by analogy may be better than nothing, but it may be worse than no response at all. Disciplinary methods that work in one home or school may be quite out of place in another.

The individual can, of course, try out one solution after another with the hope that some time he may hit on the correct one. Or he may try some of them out mentally, thinking through what the consequences would probably be and accepting or rejecting them on that basis.

Mental trial and error. Such a process of mental trial and

error was described by Sir Francis Galton in an introspective passage which reveals the mental processes of a brilliant mind. He writes.

> There seems to be a presence-chamber in my mind where full consciousness holds court, and where two or three ideas are at the same time in audience, and an ante-chamber full of more or less allied ideas, which is situated just beyond the full ken of consciousness. Out of this ante-chamber the ideas most nearly allied to those in the presence-chamber appear to be summoned in a mechanically logical way, and to have their turn of audience.
>
> The successful progress of thought appears to depend—first, on a large attendance in the ante-chamber, secondly, on the presence there of no ideas except such as are strictly germane to the topic under consideration; thirdly, on the justness of the logical mechanism that issues the summons. The thronging of the ante-chamber is, I am convinced, altogether beyond my control; if the ideas do not appear, I cannot create them, nor compel them to come.[1]

Such a figurative introspection is illuminating, but it does not exactly clarify the conditions under which effective problem-solving takes place, nor does it suggest helpful procedures in developing the ability in children.

Record of children's thinking. The child-study movement brought with it a number of diary records of observations of children's behavior including their thought processes, of which the following excerpt from the pioneer in this work will serve as an example. Here are described the actions and words of a child making his first spoken judgment:

> The twenty-third month brought at length the *first spoken judgment.* The child was drinking milk, carrying the cup to his mouth with both hands. The milk was too warm for him, and he set the cup down quickly and said, loudly and decidedly, looking at me with eyes wide open, and with earnestness, *heiss* (*hot*). This single word was to signify "The drink is too hot!"

In the same week, at the end of the ninety-ninth, the child of his own accord went to the heated stove, took a position before it, looked attentively at it, and suddenly said with decision, *hot* (*heiss*)! Again, a whole proposition in a syllable.[2]

Observation of animal behavior. An account given by C. Lloyd Morgan[3] of the actions of his dogs when he threw his cane over the hedge for them to retrieve illustrates an intermediate stage between observation and experimentation. The dogs could go through the hedge all right, but when one returned with the cane crossways in his mouth, he couldn't get back! The cane was dropped, the dog came through, went back, picked up the cane, and was again blocked. Only when the dog accidentally picked up the cane by the handle, letting it trail along on the ground beside him, was he able to bring it back to his master. In some cases repetitions of the problem situation brought consistently successful responses.

2. MAZE AND PUZZLE-BOX EXPERIMENTS

The first maze. At the turn of the century, E. L. Thorndike for the first time attacked the question of problem solving in a purely experimental manner. His innovation consisted of the use of the maze and the puzzle box, techniques which have since been modified and elaborated and their use extended to nearly every psychological laboratory in the country.

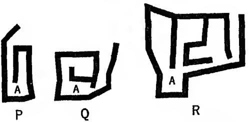

FIG. 68. GROUND PLANS OF THE FIRST ANIMAL MAZES [4]

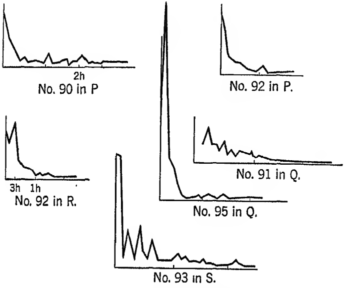

FIG. 69. SAMPLE TIME CURVES SHOWING THE PROGRESS OF CHICKS IN ESCAPING FROM PENS [4]

The chicks were placed at *A*, escaping from *P*, *Q*, and *R* (Fig. 68).
S is a slightly more difficult maze. In this and in Fig. 73, each mm. above the abscissa represents ten seconds, and each mm along it, one trial Short lines below denote a day interval between trials, small figures followed by an *h*, the number of hours.

Thorndike's first maze was a simple affair, consisting of books set up on end, and his subjects were tiny chicks. The ground plans of some of his mazes or "pens," as he called them, are shown in Fig. 68. The chick was placed at *A* and left to find his way out, with the results shown in Fig. 69. He writes as follows concerning the behavior of a chick in the improvised pen:

> When taken from the food and other chicks and dropped into the pen, he shows evident signs of discomfort; he runs back and forth peeping loudly, trying to squeeze through any

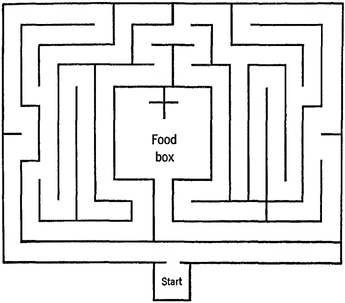

FIG. 70. GROUND PLAN OF THE HAMPTON COURT MAZE[5]

openings there may be, jumping up to get over the wall. In scientific terms this history means that the chick, when confronted by loneliness and confining walls, responds by those acts which in similar conditions in nature would be likely to free him. Some of these acts lead him to the successful act, and the resulting pleasure stamps it in. Absence of pleasure stamps the others out.[4]

Maze-learning Since these pioneer experiments in maze-learning were performed, almost all kinds of animals from turtles to horses have had mazes constructed for them, but the white rat is the most popular as a subject. He is small, has a nice disposition, is inexpensive, breeds rapidly, and learns well. One of the earliest rat mazes used was modeled after the famous labyrinth of evergreens constructed for the amuse-

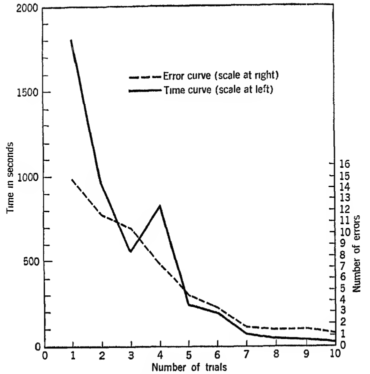

FIG. 71. TIME AND ERROR RECORDS OF WHITE RATS[5]
First Ten Trials in Learning the Hampton Court Maze (Fig. 70).

ment of the royal guests at Hampton Court. The time for the solution varies with the intelligence of the rats, but the general form of the curve of learning is illustrated in Fig. 71. Gradually the rat learns not to enter the blind alleys so that finally he scampers along the correct path as fast as he can go.

The first puzzle boxes. The other innovation in technique introduced by Thorndike in the study of problem-solving in animals was the *puzzle box* (see Fig. 72). For these experiments

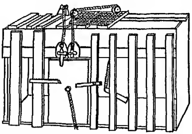

FIG. 72. DRAWING OF BOX *K* USED BY THORNDIKE IN HIS EXPERIMENTS WITH CATS [4]

cats were used. The cat is placed inside the box, the door of which may be opened from within with such motor skill as all cats possess, by pulling a looped string, lifting the latch, or in other ways. Outside the puzzle box some tempting food serves as a lure. Indeed, this double stimulus — confining walls and outside lure — is one of the objections to this form of experimentation. In some later researches, the situation was reversed, the food being placed inside the box and the cat outside.

In both situations, however, the results were virtually the same, though the former tended to make the hungry cat a little more frantic. Many unsuccessful trials in which the animal attempted to reach through the bars or clawed at the string, were followed by occasional successes, becoming more frequent until the solution was found. If the box was simple in that only one bolt had to be released, the learning was rapid. If the locks were more complicated as in Box *K*, the learning took longer. The solution is explained on the basis of *repetition* and *effect*. As Thorndike describes the process, "Gradually all the other non-successful impulses will be stamped out, and the particular impulses leading to the successful act will be stamped in by the resulting pleasure, until, after many trials, the cat will, when put in the box, immediately claw the button or loop in a definite way."

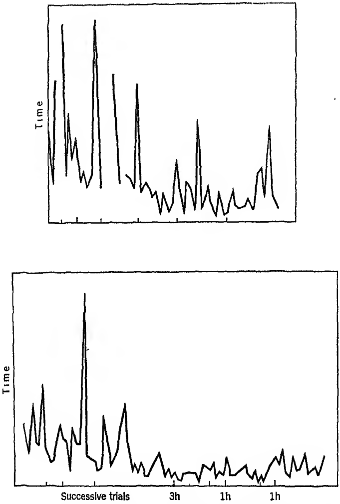

FIG 73. TIME CURVES SHOWING THE TRIAL-AND-ERROR PROCESS BY WHICH TWO SIX-MONTHS-OLD KITTENS SOLVED THE DIFFICULT BOX *K* (FIG. 72) [4]

Human trial-and-error learning. It may readily be seen that human beings sometimes find themselves in situations like that of the rat in the maze or the cat in a puzzle box. For example, an unfamiliar row of electric switches must be tried out in a random, trial-and-error fashion, if one wants to turn on a particular light with one of them.

Indeed, "stylus mazes" have been devised for human subjects which consist of grooves that one follows with a stylus or a pencil, blindfolded. Success in such a maze is often no more quickly attained than it is by the rats in one with the same ground plan.

The human subject wants to see the situation as a whole, either as it is, or symbolically represented by a map or diagram, or perhaps in his imagination. When this is impossible he flounders around, and much valuable time is wasted. Children often do arithmetic problems or attempt translation in a similar fashion. Teachers are needed to reduce this wasteful trial-and-error process; not to show the pupils just the right way to do everything, but to furnish the suggestions and the help which will enable them to do the same kind of thing themselves.

3. GESTALT EXPERIMENTS

Umwege. There is apparently an ability which human beings possess to short-circuit the trial-and-error process, and learn to solve problems without going through all the motions required in pounding in the correct response by repetition and resulting satisfaction. Efforts have been made to discover this ability under experimental control in animals, but none of them was particularly noteworthy until Köhler's famous experiments with chimpanzees.

Wolfgang Köhler (1887–), formerly of the Psychological

Institute of the University of Berlin, had for some time been interested in the question of problem-solving and its relation to perception. Believing that the blind features of the maze and the puzzle box did not give the experimenter any clear idea of how the animals solved their problems, he evolved a different technique which goes by the German name, *Umwege* [6] method, or *ways around* the obstacle to the lure or goal. The subject in these experiments does not wander about helplessly until he hits upon the solution by chance, as the chick or rat in a maze seems to, or a hen trying to find a hole in a fence. After a period of failure and uncertainty, he comes to the solution all at once, like a dog running around a shed to get through the gate. In such a case, does the dog know his way around? Or does he think of it? Does he have ideas?

Chimpanzee learning. Because the chimpanzees are the most intelligent animals below man, it would be natural to find mental processes more like those of human beings operating in them but perhaps in an elementary form. A chimpanzee reaches through the bars of his cage for a banana, but it is too far away. He sits down a while or walks around the cage. Then of a sudden he picks up a stick the experimenter has left inside the cage and hooks the banana in with that. Or a banana is hung up out of reach. The chimpanzee brings over a wooden box and climbs up on it to get the banana, or he piles up two or three boxes, or climbs up a pole, grabs the banana, and drops to the ground as the pole falls.

What happens in these and similar experimental situations? Surely there is no "trial and error" to speak of. Perhaps he misses the banana once or twice in attempting to rake it into the cage, or doesn't get the box exactly under the banana at first. But the time spent in such minor errors or in waiting about is not particularly significant, and there is no hammering

in of the correct response by repetition. The time curve, if one were to plot his learning, would drop at once from consistent failure to consistent success. Indeed, some writers have pointed out that some of the curves of Thorndike's cats did almost that, occasionally, as did some of those of the chicks as shown in Fig. 69.

Insight and Gestalt. One way to explain such a solution when it is first arrived at is to say that the animals had "insight," that they thought it out, that they used ideas, or made an inference. But this may or may not be true according to the meaning of those terms. We do not know what kinds of ideas animals have.

The Gestalt psychologists say that the animals combine two segments or patterns of experience. As long as the stick is just one more thing in the cage, that pattern of experience is of no use in solving the problem. But when it becomes a part of the banana-seeking experience, the connection is made, and the food is obtained. As long as a box is only something the keeper sits on, it doesn't help any. But when the height experience of climbing onto the box and of trying to reach the banana are brought together in one pattern, the solution is found.

In one instance, a chimpanzee tore a loose stick from a crate and used it to hook the banana into his cage. Here the usual crate pattern as one whole thing is broken up, and an actual part of it becomes a part of the other operation. To use the terminology employed in connection with the perception of visual patterns in Chapter IX, certain elements in two formerly separate situations become the figure, and everything else the background. As long as the whole crate was the figure, nothing happened; but when a part of it, with the banana, stands out in one pattern and the rest of it is background, the way is open for a solution.

Suggestions. Some say that the Gestalt hypothesis is little more than the old idea of apperception with a new name, a dynamic view of the association of ideas. There is enough that is new in it, however, to make it worthy of separate consideration, particularly since it has stimulated so much experimentation. Rats have been run on elevated-pathway mazes, thus giving them an overview of the problems they are to solve. Dogs have dragged boxes around obstacles and climbed upon them to reach a cord which, when pulled, brings them their food. Nursery-school children have been put through most of the chimpanzee experiments with some new ones added, and with surprisingly similar results. And more complicated situations have been devised to illustrate this form of learning on the part of high-school and college students.

In the case of human subjects, the rôle of hints or suggestions is particularly interesting. A child in a baby pen desires a toy that is outside. The experimenter gives him a suggestion by reaching through the bars of the pen. The child then reaches through the bars, but where the experimenter is, on the opposite side from the toy. The experimenter is in the pattern instead of a reaching arm. Another child had seen the experimenter knock a toy from a ledge on the wall with a stick; but he couldn't get the stick out of the background and into the figure, for he persisted in holding the stick in one hand and reaching with the other.

College students as subjects were asked[7] one at a time to tie two strings together which were hanging from the ceiling far enough apart that they could not both be reached at the same time, even though the subject kept one in his hand and walked as far as he could toward the other. A few subjects solved the problem at once. For the others, the experimenter walked into one of the strings, leaving it swaying a little. To a few more subjects, the string thus became a pendulum.

They immediately tied a weight on the end and swung it until they could reach it while holding the other string.

These and other experiments suggest the significant rôle that *suggestions* play in thinking. The teacher does not want to tell the children exactly what to do all the time, but instead he may wish to make some of the elements in the situation prepotent so that they may solve their own problems. If a child is left alone he may helplessly wait, as in Galton's introspection, for an idea to enter from the "ante-chamber," or he may waste a lot of time in fruitless trial-and-error fumbling, or even break apparatus or injure himself or others by doing the wrong thing. Between these two extremes lies the method of suggestion. But the suggestion, if it does not call up the right Gestalt or pattern, leads either to other blind alleys, or perhaps to nothing at all.

4. PROBLEM-SOLVING

Life difficulties and scientific problems To the low-grade feebleminded, well cared for in an institution, life presents few problems. For those of average or superior intelligence, there are many, and the question, "What is to be done about this?" is constantly recurring. A single problem and the difficulties it presents may occupy the whole professional life of a philosopher or scientist. The teacher makes a business of presenting problems to the pupils, and indeed, life for most of us seems to present a succession of problems to be met somehow or other.

It will be convenient to distinguish between life problems [8] and scientific problems. The former are familiar enough — actual difficulties which demand some response which is not immediately available. The individual does the best he can, relying on experience and intuition, and deciding whether he is right or wrong from the clash of subsequent events. He

may content himself with a poor solution if the consequences are fairly satisfactory, or he may by chance hit upon the best solution. In any case, he is discovering what to do in a particular situation.

The scientist, on the other hand, is searching for generalizations, for principles which apply to or show relationships between a number of different phenomena. He wants to be able to say that when such and such conditions are found, certain things are bound to occur, and to state this fact quantitatively as a formula or law. The careful methods of the scientist in forming his hypotheses and checking their validity furnish an excellent guide to the individual in attacking his own difficulties and finding the best solutions of his problems.

Isolation of the problem. The first step in solving a problem [9] is to separate the particular difficulty from its surrounding mass of difficulties, events, facts, emotions, and personalities. The problem of the chimpanzee was to get the banana, of the child to get the toy. But difficulties do not always present themselves so clearly. Everything may seem all wrong, in which case there may be a whole cluster of problems which must be attacked separately.

Thus the vaguely appreciated problem of the boy or girl, how to make friends, resolves itself into such separate questions as: How can I improve my appearance? How can I seem as cheerful and friendly as I feel? How can I help other boys and girls so they won't resent it? What should I say on such and such occasions? How can I entertain my friends when I have so little money to spend?

The difficulties that a teacher encounters in coming to a new school raise such questions as the following: How can I improve the learning of the children? How can I best adjust to the community life? How can I adapt my work and ideas to what the superintendent wants? How can I get on with cer-

tain of my colleagues? What is the best way of dealing with some of the more difficult children? — and many others including such personal problems as where to live, where to eat, how to budget time, what acquaintances to follow up, and so on.

Analysis and abstraction. The process of breaking up a whole into its parts with a view to finding out more about the parts and hence about the whole is called analysis. A whole to be analyzed may be a chemical compound, a mental process, or a social situation. One may analyze his attitude toward another person, or his idea of art. It is the process of taking the clock apart to see what makes the wheels go around, and hence by itself is destructive.

An examination of the parts, however, may show what is defective in the whole: why the clock didn't go. An analysis of the processes a child goes through in multiplying, for example, may show a number of habits which lessen his efficiency, such as a weakness in the fundamental processes which causes him to start at the beginning of the multiplication table when he wants the product of 8 times 9, or an inability to "carry," or to handle decimals. If the weak element in the chain is *abstracted* or taken out for special study and training, efficiency in multiplication is increased. The same thing applies to the other school subjects. Similarly, an analysis of the difficulties of a so-called problem child may show that certain previously unsuspected conditions may be the cause of the undesirable behavior.

To many people, the word *abstract* means obscure or difficult, in spite of the fact that they have been employing abstractions with the greatest of ease since childhood. Almost every word ending with "-ness" is abstract — roughness, for example. It stands for a characteristic quality of many things such as sandpaper, coarse wool, unplaned lumber, and the like.

It refers to a perceptual quality or experience which is abstracted from a number of different experiences. Similarly, the meaning of roundness is developed by the child's contact with things which are round, whatever other attributes they may have, such as balls, wheels, coins, and the like.

Number is an abstraction, too. There is no such thing as four. There are four things — be they apples, sticks, fingers, or quarters; and early in his educational career a child learns to abstract this quality from the others which things possess, until he can deal with number relations without thought of the things themselves. Algebra carries abstraction one step further. For when the pupil decides to "let x equal the number," he has a symbol which stands for an unknown numerical quantity.

Symbolism and personification. Words and numbers, and in the case of algebra, letters, then, are or may be symbols which stand for abstractions. And education is in large measure the process of learning to manipulate such symbols. Mathematics provides practice with numerical and other quantitative symbols, and reading, writing, and speaking, with verbal symbols. When one inquires the meaning of a word, such as "energy" or "statics," "justice" or "democracy," or "art" or "beauty," one seeks to find the particular elements or qualities which are abstracted from more complex phenomena and brought together under these terms. Some symbols are represented pictorially, or as actual objects "stand for" certain aspects of human relations, such for example as the crown and scepter, the cross, the flag, the badge, the uniform, the sword, the coat-of-arms, the trademark, and the Christmas tree.

Indeed, the symbols employed to express abstract relationships sometimes take on so much reality that they are given personal attributes. Thus for the Greeks, Zeus was the

personification of power, Venus of beauty, Ceres of the harvest, and so on, and these values so personified became objects of veneration, while in our own day the cartoonist's representations of John Bull, Uncle Sam, and others personify certain aspects of the interrelationships of millions of people.

Acquisition of abstract meanings. An older educational theory was content to teach definitions of abstract meanings with the belief, apparently, that if the definition was memorized the meaning would be known. Thus if a child could say, "A word that expresses action, being, or state of being is called a verb," or "Parallel lines are lines which do not meet however far they are produced," or that "Arithmetic is the science of number," it was supposed that he knew something. And perhaps he did. The chances are, however, that all he knew was the verbal hocus-pocus which served as a charm to get him the teacher's praise and a good mark.

If abstract meanings are really understood, they must be abstracted by the children themselves from their own experiences, experiences with rough and smooth things, with round and angular things, with beauty and ugliness, with justice and injustice, with democracy and dictatorships, and their consequences for individuals.

A teacher of any subject, whatever it may be, is also a teacher of abstract meanings. Words like attribute, dynasty, commensurate, compromise, longitude, orientation, civil, prodigal, static, economic, inflation, feudal, heresy, honesty, and sportsmanship are but representative of many whose meanings children must be helped to acquire by directing their attention to certain aspects of experiences they have had or by providing experiences for them.

As analysis is the process of taking things apart, so *synthesis* is the process of putting them together. The one is tearing down, the other is building up. In fact, analysis im-

plies a previous synthesis, for if things were not together, they could hardly be taken apart. Synthesis in psychology really means the construction of new patterns or wholes from those which are at hand. Thus the acquisition of abstract meanings and the solution of problems involve both processes.

Tentative solutions. When a problem has been isolated or perhaps analyzed into parts which are themselves clearly stated subordinate problems, a number of solutions may suggest themselves; things to try out to see if they work. People differ widely in the matter of *fertility of suggestion*, as we have seen. But the possibilities that suggest themselves may actually be tried out, as in picture puzzles, or they may be tried out mentally, as when one figures out the best way to get to another part of the city without actually traveling over all the possible streets.

When a solution does not work, it should naturally be discarded and another one tried. Subjects differ markedly in this matter of *flexibility*;[10] sometimes a person will try to fit two pieces of a puzzle together dozens of times when it should have been clear the first time that they did not fit.

Similarly a pupil will often make the same mistake again and again in spelling or arithmetic computation or in geometric demonstration, or in conduct, instead of trying out a new way which at least *might be* the right one. The force of *precedent* holds societies to the old forms even though new conditions demand new solutions to social problems. Capital punishment, slavery, and war seem to fall into this category, while in the educational sphere corporal punishment, formal discipline, and verbal teaching, which appear to be equally helpless in coping with the needs of youth, nevertheless continue to be employed.

In scientific research, the word *hypothesis* is used to apply to a tentative solution which is being tried out; and intelligent

research work, like intelligent problem-solving, requires the rejection of the untenable hypothesis. If the hypothesis "works," that is, if the expected or desired results are obtained by a certain means, that problem is solved. In a different situation in which, however, the significant conditions seem to maintain, the same solution can be used again. If it doesn't work, then the significant conditions are different and a new solution must be sought.

5. THE SCIENTIFIC ATTITUDE

Scientific method [11] furnishes helpful guidance in the proper manner of attack on life problems. Besides the basic necessity for a certain *fertility in suggestion*, and *flexibility* in the acceptance and rejection of tentative hypotheses, other characteristics of this method may well be appropriated by everyone. And it is one of the most important tasks of the teacher to develop scientific habits of thought in children and young people. We may therefore discuss with profit some of the more important characteristics of the scientific attitude.

Impartial. Science is impartial. Experimental studies show the desirability of a purely intellectual and detached, unpartisan attitude toward the problem. It is not necessary to take sides except as the data direct. In debate, one champions one side and defends his position against all attack, sometimes even trying to make the worse appear the better reason. The scientist may be extremely critical of any opposing hypothesis, but he is ready to give up his position as soon as the facts have been shown to be against it.

Empirical. Science is empirical. It is suspicious of all authority. An authoritarian statement made by some man, read in a book, or given out by some organization is to him just another hypothesis which may be accepted as true only

to the extent that it is supported by the facts, and may be assumed to be false if it comes from those who are without experience in the matters concerned.

If children are free to question instead of accepting passively what they are taught, the chances are that they will not become such easy marks for peddlers of physical, mental, or political nostrums. They may question the multiplication table, what the book says about frogs, or the social and political practices of the present if they wish, providing they have the skill and access to empirical findings to check their conclusions against those they find "in the book." The best kind of indoctrination would seem to be an indoctrination which inculcates a respect for the facts and a dissatisfaction with all careless or slipshod thinking about them. A circumscribed experience may make the acceptance of authoritarian statements wiser for the time being, and they may turn out to be valid; but if they are held tentatively there will be no heartbreak if they must be given up.

Observant. The method of science depends primarily upon the careful *observation* and *record* of data. The scientist observes animals, physical phenomena, earth conditions, human reactions, or whatever he may be most interested in, and makes a graphical or numerical record of what he has observed. The microscope, the telescope, and the camera allow observations to be made of things which are invisible without them. Even now psychological and sociological observational techniques are being developed which will undoubtedly effect profound changes in the treatment of children in school.

But the naturalist who observes animals in their natural surroundings is but laying the foundation for a science. The essence of scientific work is the *control* of environmental conditions with a consequent control of the phenomena studied.

Iron is observed under various conditions of heat and pressure, the organs of the body are observed in their reaction to various chemicals, and so on. The control-group technique for a more accurate observation of otherwise uncontrollable conditions has already been discussed.

An *experiment* involves the setting up of conditions, all of which remain constant, except one, the *variable*. If temperature is the variable, the iron is subjected to varying degrees of temperature in known amounts, while other conditions are the same. Any changes in it will then be due to changes in temperature. Or the variable in other experiments may be the pressure, the moisture, the incentive, the complexity of the task, the brightness of the light stimulus, or the amount of a drug administered. By employing a *single variable* the experimenter can observe his data under conditions which he can control, and thus he can determine cause-and-effect relationships.

Precise. The exactness of scientific work sets it off from usual problem-solving. No longer are we content with guessing the time of day from the position of the sun, nor the temperature from the way we feel. The length of the chieftain's foot or of his arm,[12] are inadequate feet and yards, and the distance a man can travel in a day is too variable an amount to be of much use. Science has progressed only as precise quantitative measures have been developed.

Similarly, we are no longer content to trust our judgment about the brightness of a child or his degree of achievement in school subjects. Energetic work has been going on during the past decade to attain greater precision in mental and social measurements; and the means already worked out are of considerable value.

Cautious in generalizing. If it is found that iron expands with heat, one may tentatively conclude that iron always

expands with heat. But it would be well to try the experiment over again with different pieces of iron and at different temperatures before generalizing. If the same result is noted every time the experiment is tried, one may conclude that the same thing will occur under the same conditions at any other time. Such a conclusion assumes that we live in a world of *order* and regularity, one which can be counted on. Otherwise it would be necessary to try every piece of iron before being sure, and our world would be one of *caprice.* We could not be sure whether the sun would rise tomorrow or whether lead would float or sink.

It is a common thing to hear people generalize easily from one or two cases. Such generalizations are frequently made about persons of any religious denomination, political party, country, or race. *Stereotype* is the name given to such a judgment based on insufficient experience, and is responsible for many social attitudes and prejudices.

It is of course impossible to observe *all* foreigners, or Americans, or all monkeys or cats, but a *random sampling* of sufficient size must be observed, one which it is agreed is typical of the larger group, before generalizations may be made. Then characteristics of these under certain conditions may be considered as characteristic of others, unless there are facts to the contrary. The jump from the few cases observed to the many about which one generalizes is called the inductive leap. Scientists are careful not to leap too far in making a generalization.

A further caution about generalizing should be urged. One frequently seeks to explain an event in terms of other known events. One might attempt to explain the upward leaping of the flames by considering it a desire on their part to get to the sun, the source of all heat and light, or the waves seeking the level of the sea as their filial longing to return to mother ocean.

This sort of thing used to be more common than it is now. But there is still a temptation to explain things like hypnotism and insanity in terms of devils or unknown spiritual symbols, and animal behavior in terms of human thought and emotion.

As a guard against this tendency to explain what we know about by referring it to some higher category of things which may not apply at all, a medieval scholastic, William of Occam, laid down the rule. "Never multiply theoretical assumptions unnecessarily" And Morgan stated the rule for psychology, which is now known as *Lloyd Morgan's Canon,*[13] as follows: "In no case may we interpret an action as the outcome of the exercise of a higher psychical faculty (or psychological process) if it can be interpreted as the outcome of the exercise of one which stands lower in the psychological scale (or, in terms of processes which stand lower in the scale of psychological evolution and development)."

Thus one is kept down to known laws and conditions if they can be shown to apply, instead of trying to explain things in terms of phenomena one knows even less about.

Problem-solving in school subjects. Obviously the operation of the thought processes interpenetrates all the school subjects. The extent to which thinking is done by the pupils depends less upon the subject being taught than it does on the way it is taught. Geometry and science are supposedly the fields where problems are solved by pupils, but these subjects may call for the exercise of memoriter learning instead — more than spelling or shopwork.

By the use of the problem method it was sought to overcome the tendency of the schools to emphasize remembering at the expense of thinking, though this method may be wasteful of time and energy if it is overdone. Children may as well be told some things, and one needn't present everything in the form of a problem. However, the method adds zest if it is well

handled, and the outcomes should be richer than in the exclusive use of a memoriter or a recitation method.

A relatively new adaptation of the problem technique has recently been developing. By a process known as *group thinking*,[14] children are led to discuss and work out together solutions of their common problems. There is danger of profitless talk, however, unless the discussion leads to action. The technique is not easy to employ, and in disciplinary situations, for example, the teacher or administrator is often inclined to handle the matter himself instead, just to get it done. But there is plenty of evidence in the practices of the adult world that experience is needed in just this sort of thing — sitting down around a table, as the phrase is — if complex social problems are to be satisfactorily met.

Scientific method in education. In his professional preparation, the educator is referred to numerous research studies in education. While many of these do not successfully meet the canons outlined in this chapter, the phrase "a science of education" is far from being a misnomer. The problems in this field are numerous; and while large research projects may seem to be more effective than individual inquiries, there is a need for teachers to have a clear understanding of the meaning of science in education [15] and of the research techniques [16] involved. They may thus continue in touch with the explorations going on when their professional training, as such, is over; they may participate intelligently in cooperative researches, and they may conduct studies of their own which will help them meet problems which may be peculiar to the local situation.

The quest for order. Scientific research builds up theories from its hypotheses, and laws from its theories, if it can do so. These laws are statements of uniformity to the effect that when certain conditions are found in certain amounts, other condi-

tions are always found likewise in certain amounts. Unlike legal enactments, natural laws cannot be obeyed or disobeyed. They are statements of the way things happen under certain conditions.

Psychological laws are not yet formulated in precise mathematical form. But more and more the *probability* of regular responses to constant conditions is being determined. The same methods, however, underlie the research in the older and the newer sciences and the ways that any individual solves his life problems. No final answer can be expected, for each new discovery, each problem solved, opens up new difficulties to be met. Thus the life of an individual, be he scientist or ordinary citizen, offers a continuing quest.

Summary. While a problem may be met in any one of many unsatisfactory ways, an attempted solution is apt to be a response to parts of it which are prepotent or are analogous to parts of other situations to which the individual has learned to respond adequately.

Introspections, records of observed behavior, and experiments have sought more light on the question of the nature of the thought processes. Maze and puzzle-box techniques supported the trial-and-error formula, according to which there was a gradual elimination of the wrong responses and a more frequent repetition of the rewarded responses. Gestalt experiments presented evidence that the solution, when it came, appeared suddenly, and continued in subsequent trials, and this was explained on the basis of a combining of patterns of wholes which remained separate until the solution appeared.

Reflective thinking, whether in relation to personal or scientific problems, involves analysis, abstraction, and synthesis. Many possibilities of error are always present, among them those connected with symbolism and personification. But if the various characteristics of the scientific attitude are

properly regarded, both in one's own thinking and in instructional procedures, fewer erroneous conclusions may result.

QUESTIONS

1. What are some of the things a person sometimes does, when confronted with a problem, which do *not* illustrate intelligent problem-solving?
2. Recall any incidents you can of the intelligent behavior of animals or small children. In what ways do they fall short of being scientific evidence?
3. In what specific respects are children in school often left to discover less satisfactory ways of meeting their academic and social difficulties by a trial-and-error method?
4. What are some of the differences between the animal experiments of Thorndike and of Kohler? Do these differences account for the differences in the results?
5. What is meant by *Gestalt*?
6. Recall some occasion when you suddenly thought of a way out of a difficulty. How did you happen to think of the solution? Does it seem that parts of two experiences joined to form a new pattern?
7. What light does Gestalt psychology throw upon the technique of suggestion in teaching?
8. In what ways are objective symbols and personification used in political and religious organizations? Might there be some advantage in using more of them in education?
9. Select some problem which confronts you and endeavor to analyze it, checking the validity of your hypotheses with the possible consequences of each, and try to reach a solution.
10. In what ways may each of the characteristics of the scientific attitude be helpful in the solution of life problems?

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CHAPTER XIII

MENTAL IMAGERY AND CREATIVE IMAGINATION

Perception and reality. Perceiving is a process of selecting and combining sensations in such ways that the resulting pattern has meaning for the individual. This meaning must, of course, be in terms of his past experience. It might therefore be supposed that what a person perceives, whether it is a table or a book or anything else, is really "there" just as he perceives it. Even in the case of familiar objects this is only approximately true, however. A table may be perceived as having a circular top, though it looks this way only from the chandelier above it. A book is perceived as having a uniform green color, though when lying partly in the light and partly in the shade, distinctly different color sensations are received by the eye.

Thus the observer "reads into" what he sees the previous experiences he has had, with the result that he often "sees" what isn't there at all. This is particularly true in the case of objects whose outline is not clear, like a vague form in the darkness, which may seem to take on the semblance first, perhaps, of a woman, then of a man with a long coat, and finally is recognized as a tree stump. Under experimental conditions[1] subjects have been shown a faint irregular patch of yellow projected on a screen and have often been unable to report correctly whether the actual color was there or not. Thus what is perceived is in part what is imagined.

I. AFTER-IMAGES

Negative after-images. The projection of subjective experience into the external world is most clearly illustrated by the phenomenon of the negative after-image. If a colored disk is held against a medium gray background while the subject focusses his eyes intently upon the center of it, when the disk is removed, its shape will be seen as if on the gray background. But its color will be *complementary* to that of the original color. If the disk is black the negative after-image will be light, and if white it will be dark.

The colors of the after-image are somewhat duller and more "washed out" than the originals, the outline is not so sharp, and the after-image itself, of course, moves with the movement of the eyes. It can be thrown on any surface, and can also be "seen" with the eyes closed as if on the inner surface of the lids. After-images are sometimes so obtrusive as to be troublesome, as when one is driving a car toward the west just before sunset and dark lavender or purple after-images of the sun float about before one's eyes.

Positive after-images. When the image is seen in its *original color* instead of the complementary color, the phenomenon is called a positive after-image. The effect can sometimes be produced visually by looking fixedly at a light object like a sheet of paper under strong illumination and then switching off the light. Though the paper is removed, it still seems to be visible, glowing faintly white in the surrounding darkness. Both positive and negative after-images, or after-sensations, as they are more properly called, are phenomena of the sensory receptors rather than of the brain and are therefore said to be peripheral in origin. They represent the continuation of the effect of the stimulus on the sense organ after the stimulus itself has been removed. Thus the ringing in the ears after

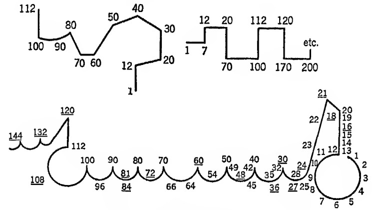

FIG. 74. VISUALIZED LINEAR NUMBER ASSOCIATIONS
(After Galton [2])

hearing a shrill sound, or the pain immediately following a blow, would also be classed as after-images or after-sensations.

Synaesthesia. There is a form of imagery reported by some which, strictly speaking, is not an after-image at all, for though like a visual after-image in its seeming objectivity, it accompanies the stimulation of other sensory receptors. The phenomenon is known as synaesthesia or color association. The individual experiencing it may report that for him tones have colors — that middle C is red, for example, G is blue, or that the sound of a trumpet is orange while that of a violin may be purple. In rare cases vowel sounds, numbers, and tastes also have different colors. Another peculiarity of a similar sort is the special system in which some people visualize numbers.[2] (See Fig. 74.)

2. MEMORY IMAGES

Galton's experiment Quite different from the real after-images, however, is the ordinary imagery of remembered

things. It differs in vividness, in the length of time of its reinstatement after the original sensory experience, and in its more unlocalized character. Memory images are not peripheral; they are called centrally aroused sensations. There are wide differences between individuals in the vividness of their mental imagery and in the sensory avenues most strongly represented.

By inquiring of a number of people, Galton[1] discovered many facts about imagery which were not realized before his day. He asked them, for example, to report the imagery of the breakfast table along the following lines: "Is the image dim or fairly clear? Are the colors of the china, of the toast, bread-crust, mustard, meat, parsley, or whatever may have been on the table, quite distinct and natural?" He also asked different persons to rate their imagery for the different senses as very faint, faint, fair, good, or vivid and comparable to the actual sensations, suggesting such samples as the following: light and color — an evenly clouded sky, a thick surrounding haze; sound — a church bell, the hum of bees; smells — tar, roses, gas; tastes — salt, sugar, lemon juice; touch — velvet, silk, soap; other sensations — heat, cold, hunger, fatigue.

Some were unable to report any imagery of the breakfast table at all, though they recalled the events quite clearly. Others described in vivid detail the color of the tablecloths, the dishes, the complete pattern of the room, the people present, and so on, insisting that they could "see" them almost as clearly as if they were present before their eyes.

Some saw little "in their mind's eye" but reported the sound of the clatter of dishes, the conversation, the scraping of chairs on the floor, and so on. A very few reported olfactory and gustatory images, such as the smell or taste of coffee.

Imagery and meaning. To those who have no mental imagery to speak of, all these reports seem like sheer nonsense.

To those who have it clearly, mental imagery seems to be the basic mental content, the stuff of which ideas are made. A moment's thought, however, is sufficient to banish this fallacy. If the word tree is mentioned, and one person images a pine and another an oak, this does not mean that the two would differ as to what a tree is. The concept is deeper than any imaginal representation of a particular object. One individual, making an introspective report, stated that he could discover no other mental content when the word "England" is spoken than a slight kinesthetic sensation about the eyes as if he were trying to read the fine print on a map. Such a person would not be capable of any very clear thinking if he were dependent upon his mental imagery.

Imageless thought. Apparently, memory images accompany thinking, perhaps directing it somewhat if they become symbols for concepts. But they are quite helpless in the face of abstractions. What imagery except of a vague symbolic sort might one conjure up, for example, to represent his idea of an honest man, or of cooperation, or mechanics, or charm? Thought may be imageless, and when it is not, the imagery is little more than an accompaniment serving to represent particular sensory and perceptual experiences and only symbolically to stand for generalizations or abstractions.

Imagery types. If one placed the different senses on a scale of frequency of occurrence of their accompanying imagery, vision would come first, hearing second, touch probably third, with smell and taste in the fourth and fifth places. Kinesthetic, static, and organic memory images, it is believed, do not exist as such, but when reported are probably sensations, in that actual stimuli are affecting the receptor organs concerned.

People whose prevailing imagery is visual have been called visiles; while others whose imagery is predominantly auditory

and tactual, respectively, have been called audiles and tactiles. Some tend to have verbal imagery, that is, visual or auditory images of words. The question has been raised repeatedly as to whether instruction of pupils should not follow their prevailing imagery type. Should visiles see and read, audiles listen and be talked to, and tactiles feel and handle?

There are two chief reasons for not adapting in this way to these individual differences. One is that pure imagery types are comparatively rare, the great mass of people being fairly adept in all three ways. The other reason is that individuals tend to throw their experiences into their habitual form of mental imagery anyway. A child can listen to a story and picture the events described, or he can read a conversation silently and hear the words and cries of the speakers. In the case of special difficulties, however, it is often wise to try different avenues of presentation.

3. EIDETIC IMAGERY

Jaensch's experiments. A third type of imagery has recently been explored,[4] lying between the after-image and the memory image in objectivity and vividness. This is called the eidetic image. It may be called up some time after the stimulus object it represents has been removed; in this respect it is like the memory image. And it is "seen" as external to the person as if drawn or painted on a neutral gray background; in this respect it is like an after-image.

The images are said to appear in some cases with hallucinatory clarity and vividness; though in the case of an hallucination, the individual believes the object thus seen or heard is actually present, while there is no such confusion in the case of eidetic imagery. Such images are reported as most frequent in younger children ranging from around forty to sixty per cent

in some school populations investigated, though all children are adjudged to have them, if not in a vivid at least in "latent" form. The differences in the per cent of children reporting eidetic imagery are in part due to the methods of investigation used, and in part to the kind of school experiences they have had. Children who attend the freer, modern type of school are more likely to report imagery of this kind than those from the more formal, standard-type schools.

B and T personality types. The investigation of eidetic imagery has gone beyond the mere description of the phenomenon to the delineation of types of personalities showing different kinds of eidetic imagery.

The imagery of the so-called *T-type* is more like the negative after-image in that the subject fixates a part of the picture, the eidetic image is complementary to the original in color, and is inflexible in that only slight changes can be made in it and then only with considerable effort. The images themselves are felt by the subject to be alien to him, and sometimes a hindrance. An extreme case is cited of a boy who had to do all his studying the first thing in the morning. If he waited until afternoon, the things he had seen that morning would appear in the form of small pictures in his book between the lines of print.

An individual with this rigid, mechanical type of eidetic imagery is said to have a somewhat analogous type of mental organization. His eyes are small and deep set and comparatively lifeless; and he has a peculiar pinched facial expression known to clinicians as the *letany* face, whence the name tetany or T-type.

The imagery of the so-called *B-type* is more like the mental image than it is like the negative after-image. No fixation on a point of the test picture or object is necessary, merely a uniform sweeping glance; and the vividness of the image is

increased by rich detail in the test picture, and by keeping the attention and interest of the subject alive. The eidetic image of the B-type is not complementary in color to the original, and it is flexible, tending to follow changes in ideas like the usual mental imagery. Transformations take place spontaneously, continuing with the thinking of the subject. Eidetic images of the B-type are not alien nor are they an annoyance to the individual but are felt to belong, in a peculiarly personal way — "an intimate and loved possession."

An individual with this integrated, organic type of eidetic imagery is said to have an analogous type of mental organization. He is more emotional, his eyes are large and lustrous, he is gracefully built, and has soft satiny skin. He may have a slightly enlarged thyroid. These are symptoms in milder form of Basedow's (Grave's) disease, whence the name basedoid or B-type.

While the B and T are viewed as special cases of integrate and disintegrate types respectively, pure types are rarely found, individuals with mixed forms of eidetic imagery being regarded as perfectly normal, and in no way pathological.

Certain sub-classifications have been differentiated. One form of the B-type is the integrated or I_1-type corresponding to Kretschmer's pyknic.[5] Another form of the B-type is the synaesthetic or S-type, corresponding to Kretschmer's schizoid. In a third form of the B, the I_2-type, there is usually little or no visual imagery, but instead a kind of motor or dynamic feeling tone.

Imagery and the artist. If a natural sensitiveness to the world is enhanced by a visual representation of it as vivid as reality but directed by one's thoughts and attitudes, the resultant influence is naturally important in many ways. Particularly would it affect the work of the artist, though artists differ as widely as others in respect to eidetic imagery.

It is believed that Michael Angelo was thus gifted, and that he arranged his groups of frescoed figures by looking at the wall space where he was to paint them, projecting the image on it and then tracing in the outlines from the eidetic image thus projected.

Art schools which take account of eidetic imagery do so in different ways. Some encourage its development that it may serve in the way it is supposed to have served Michael Angelo, though there is some evidence that the drawings of eidetic children do not differ from those of non-eidetics. This is accounted for on the assumption that the children cannot trace the images because they are not vivid enough, or because their drawing is directed by motor rather than visual control. Others train their pupils who are already gifted with strong eidetic imagery to get along without it, since as they grow older the tendency will be for the imagery to become fainter and disappear.

4. PHANTASY AND IMAGINATION

Phantasy. The continuous form of imagery known variously as phantasy, autistic thinking or daydreaming has already been mentioned as a means of escape from the unpleasant rigors of reality. The degree to which daydreaming is carried on varies from individual to individual, but its frequency is well established. It is largely a passive process, the pictures coming and going, made up of the familiar experience of the individual but combined in new ways, with feeling and emotional elements usually present and the daydreamer himself always the center of the stage. A somewhat objective form of imaginative phantasy is that in which an individual sees pictures in cloud forms and perhaps in the flames of a hearth fire. This has been investigated in an interesting fashion by means of the

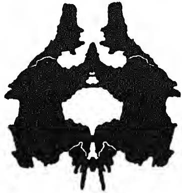

FIG. 75. SAMPLE RORSCHACH INK BLOT [6]

Rorschach ink-blot test.[7] The subject looks at ink blots which have been pressed while wet and have thus assumed fantastic outlines. He describes what they look like, much after the manner of the continuous association method. While the test is not any too well validated, interesting relationships have been found with artistic tendencies, various personality traits, and some of the typologies — notably that of Spranger.

Imagination and problem-solving. Imagination is the process by which items of experience are combined to form new products. Phantasy applies to its more passive form. In its active form imagination is directed by the individual, who, as it were, steps in and takes a part in the activity. In any case it is creative in that new combinations or patterns of life experience are constructed. These, like mythical animals — the dragon, the unicorn and the centaur — may be combinations of well-known parts, or they may be events, as recounted in fiction.

Imaginative constructions are made with different objectives and may be judged by differing sets of values. A utilitarian

purpose may dominate the inventor who is imaginatively creating a machine or a process with a view to the practicability of the product. Or the problem may be less mechanical as when an individual works out a geometrical demonstration or a plan of social or political organization.

An imaginative writer creates characters who have traits or combinations of traits he has met with in different people, and from these parts he endeavors to achieve a unified personality, making the character live, as the phrase is. Such characters are, besides, symbolic representations of ideals of one sort or another, as are also many other creations of art, particularly in pictures and sculpture.

5. ART APPRECIATION [8]

Empathy. A creation of the imagination, symbolic or not, when externalized in sound or color or form, however, is not necessarily art. Other characteristics must also be present which are primarily psychological in nature, but which are difficult to identify and describe. One of these is emotion. There must be something in the creation which arouses a pleasurable emotional feeling in the observer or listener — something about it which he accepts as a part of himself, as it were, and in which he finds enjoyment.

This "feeling oneself into" something is called empathy (the German word is *Einfuhlung*). The massive columns must give one a feeling of weight and stability; the lofty arches, of exaltation; the heroic figure, of oneself doing noble needs, and the like. Even then, with such a spiritual union and satisfaction, the beauty may not be recognized by all. Artists themselves are notorious for their disagreements about art. But an object is beautiful for the individual for whom it creates a pleasurable feeling of this sort.

Standards and taste. Standards differ with the age, and tastes vary from individual to individual. However, it is a fair assumption that the enjoyment of art increases as the individual more nearly approaches his capacity for appreciation. If he is on the level of the funny papers, jazz music, paper pulp romances, gimcracks, and gingerbread decorations, he is at a low level of artistic appreciation which, if it could be raised, might give him greater satisfaction.

Children's artistic taste is necessarily immature and may not develop unless proper opportunities are provided. But with the child as with the adult it does not do to belittle what is beautiful to them. Rather, the wise teacher will show where greater beauty lies — in this arrangement of flowers, in that line of decoration, in the working out of a musical theme, or in a treatment of light and mass in a painting or a statue.

Knowledge of an art contributes in rather definite ways to its appreciation. The craftsmanship involved, the forms which may be employed, a comparison of the work of various artists, and an appreciation of the experience or mood or ideal which is being portrayed — all these things reveal aspects of the created form to which an individual might previously have been quite oblivious.

In spite of differences of opinion about the fine points of an artistic creation, gross levels of appreciation are fairly easily recognized. The usual method of testing [9] is to present a work of art, be it a picture, a poem, or a musical theme, and along with it present a number of rearranged and variously maltreated forms of the same selection. If the subject chooses the original, which has been adjudged better than the other samples, his aesthetic judgment may be said to be better than it would be if he considered as best a modified copy that may be poor rhythmically, out of balance, or over-sentimentalized.

6. CREATIVE ART

Æstheticism. Æsthetics is in brief the field of investigation embracing the study of the relation between form and its artistic appreciation. It seeks to answer the question: What are the things which make for beauty? An æsthetic attitude may not be creative, but if it is not, it is incomplete. There are three stages:[10] first, the *impression*, emotional and appreciative, a sensuous or imaginative picture; second, the *expression*, a sensuous, concrete presentation augmented by the imagination of the artist; and, third, the *form* or concrete, empathic presentation of the fusion of impression and expression.

Artistic temperament, in the best sense of the term, is the characteristic emotional attitude of individuals who have reached the first two stages but not necessarily the last. Experiences may impress them emotionally in an artistic way which seeks expression. They may have the temperament but still be lacking in the talent to present the product of their imagination in a form which appeals either to themselves or to a wider public.

Children as creative artists.[11] Very little is known of the psychological process involved in great artistic creation, so that instruction at its best takes the form of opportunity, encouragement, and kindly criticism. The process seems to be one of allowing the creative powers of the child to develop, and on this basis rather remarkable results here and there have been obtained.

The work of one Austrian teacher[12] has attracted world-wide attention, and the decorative murals painted by his children are to be found on the walls of schoolrooms in many countries. The recent development of finger painting has provided a preliminary medium for expression as have water colors for some time, especially when the emphasis in the instructional

period is on self-expression instead of on the copying of models.

Clay modeling has long been one of the kindergarten-primary activities. Percussion instruments, some of them following primitive forms, and made by the children themselves, and the simpler musical instruments provide an opportunity for self-expression in rhythm and sound that is in harmony with the child's level of development.

In verse one need not go to the more highly publicized writings of child poets.[13] Verses of striking poetic excellence are found in the literary publications of many school papers. There are such lines[14] as the following, written by a boy in the tenth grade describing a group of circus acrobats:

> Then bowing when their lauded act is ended
> And tossing kisses, jaunty and so glib,
> I wonder if they really comprehended
> They've tickled Death along his boy rib!

Or the high-school graduation poem that begins

> The everpassing steps went by our door.
> We did not listen then, nor did we look outside;
> But now the door stands open.

Or the imaginative fragment "A Dream Ship" by a third-grade boy after his grade had visited the docks and wharves, and from a high building had seen the ships in the bay:

> Once a ship went by my window
> It was a tiny sailboat
> In a minute I was aboard
> Sailing . . .
> Sailing away!

The effects of the creative urge are described quite vividly in the casual remarks of children:

> "I stayed up nearly all night to do that. Mother came in and found me at five o'clock dressed and the light lit. I pretended to be asleep at my desk, but I was more awake than

daytime." "I wrote that notebook full and didn't eat or anything. Terrible hungry after it was done. Thought I was sick, maybe. Wasn't hungry then, though." "Everybody else was shivering with the cold, and I was sitting over in the corner working at this, and thought it was fine, and had my coat unbuttoned, too." [15]

And this description of the writing of "The Door Stands Open," the first stanza of which is quoted above, after a previous effort had been criticized as being rather trite with the usual high-school clichés:

"She went out of the room with her eyes set at a strange focus, far away. Chairs and small tables were thrust aside roughly; the door was slammed open. But she heard neither that, she claimed later, nor the laugh of the class; and had no remembrance of a precipitous exit. Her friend volunteered as an apology, 'She said she had a poem in her, and that if she had to stay in this room another minute without writing it she would scream.'" [16]

The alchemy of creative expression can hardly be more vividly pictured than it was in the explanation of a little boy of his finger painting. "There's a magic in my body that turns the oatmeal I eat into blood and muscle. When I read things and hear and see things, another magic like that puts everything together inside my body, and I can tell a story or paint a picture, and it is mine." [17]

7. VALUES IN CREATIVE SELF-EXPRESSION

Enjoyment and appreciation. Not all art classes are enjoyable, and some classes in appreciation are far from what they should be. However, with even reasonably good opportunity a child finds a genuine satisfaction in letting himself go in a medium which is to his liking. If he has some talent, so much the better; but in any case, some contact with the raw

materials of art, with colors and clay and words and notes, should provide a foundation for a richer appreciation of the works of genius, and should do much to elevate the level of the artistic taste of a community

Adjustment. There is considerable evidence that a free artistic expression tends to relieve repressions that are causing trouble in social adjustment and in school work. Childhood fears of death, of bogy men and the like, bullying behavior, stuttering, and arithmetic and reading disabilities have yielded to the satisfactions to be found in finger painting, coupled with a wise handling of the child. This medium provides an opportunity for the visualized presentation of free associations which are not easily verbalized at the early age levels, and for a catharsis, that is, a ridding of the system of the troublesome complexes.

Both processes are illustrated by a series of pictures of death, one of them entitled "Two Men Fishing Before They are Drowned," in which a child thus tried to rid himself of a domineering father and grandfather. They are also illustrated by another series of pictures of "awful things" which one child painted and then abolished by smearing his hand over the completed pictures. A rigid interpretation of symbols appearing in the finger paintings according to psychoanalytical doctrines is a dubious technique; more needs to be known about the case. The child's interpretation of his own painting may show that the symbol means something quite different to him, and that the true interpretation lies in another quarter.

Freedom to allow the children to follow their own desires seems to be the important thing:

> Leave the young child to use finger painting as an outlet for his own original fancy, whether the need of the moment is to convince himself that six times twelve makes seventy-two, or to transpose into color a poem, a sonata, or a geography

lesson. The vital thing is the creative expression, not the form which it happens to take.[18]

Discovery of talent. A third value of art teaching is, of course, the opportunity it provides for those who have talent [19] to develop it. Terman and his colleagues [20] have found, for example, that poems by some of the gifted children in the California schools are classed by a jury of competent judges as having greater poetic merit than juvenile verses written at the same ages by some of the masters of English poetry. This does not mean, of course, that the masters will continue to be outranked, but it does suggest that opportunity and encouragement may well be given to the youthful singers of our own day.

As children grow older, they of course become dissatisfied with their childish efforts and some of them will be eager for instruction in techniques which will enable them to progress with their art. The fault in the past has apparently been that the early school emphasis on techniques has quite drowned out the sentiment that sought to be expressed.

Summary. After-images or after-sensations are common to mankind, and may be viewed as a brief continuation of the operation of the stimulus upon the end organs concerned after the stimulus itself has been removed. People differ with respect to their memory images, sometimes referred to as "centrally aroused sensations," some experiencing the vivid hallucination-like eidetic imagery and others practically none at all, with all stages between. For some, the images of one sense are more vivid; for others those of another, though a mixture is more common than anything approaching a pure type.

Phantasy is a free, uncontrolled flow of imagery, while imagination involves at least a modicum of voluntary direction. In phantasy and artistic imagination and in appreciation there

is an empathic identification of the individual with the imaginative creation, and also an emotional factor which finds expression in children's art work as well as in the products of creative genius.

QUESTIONS

1. Cut out circles of colored paper about an inch in diameter and place them on a neutral gray background. Fixate the eyes upon the center of the circle for about half a minute, and then focus them on some point on the gray. Record and describe the color of the after-images.
2. Rate your memory images of the objects mentioned in the chapter on Galton's scale.
3. Is your mental imagery predominantly auditory or visual? Does it tend to be verbal?
4. Does any of your visual imagery approach the objectivity of the eidetic type?
5. Describe your imagery in phantasy.
6. To what extent does your mental imagery assist you in remembering names and faces? In finding your way round in a city? In memorizing? In solving problems?
7. Describe what the Rorschach ink blot (Fig. 75) suggests to you.
8. Can anything be appreciated that is not beautiful? That is not understood? Explain.
9. How would you communicate an appreciation of a picture, a poem, or a musical selection to one who found no beauty in it?
10. Distinguish the values of self-expression and of art training for children.
11. If possible, visit a school where finger painting is done. Discuss the matter of titles of pictures and their interpretation.
12. What is meant by appreciation? By self-expression?

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19. See G. Revesz, *The Psychology of a Musical Prodigy*, New York, Harcourt, 1925 In fictional form Romain Rolland has pictured the development of a musical genius in his *Jean Christophe.*

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CHAPTER XIV

MENTAL EFFICIENCY

What is efficiency? The individual who takes less time than others to do a certain amount of work is more efficient than they — assuming that the quality of work is the same. Similarly a student who does a number of problems quickly and correctly is more efficient than one who does a smaller number of problems more slowly and incorrectly. Efficiency is thus the relation of the work done to the time taken to do it. The work may be measured in terms of pages or chapters read or of projects or experiments as well as of problems completed. The quality of the work is usually rated in terms of marks or scores.

Learning becomes more efficient when the time taken to obtain the desired results is reduced, or when in the time usually expended there is more complete or effective learning. Increasing one's learning efficiency involves many factors, including the application of the principles of learning; but improvement can be made with comparatively little difficulty, and some, by careful application, can improve their mental efficiency considerably.

I. WORK AND FATIGUE

Muscular fatigue. One of the basic factors in efficiency is muscular fatigue. A number of pieces of laboratory apparatus have been designed to measure its effects By means of a pulley, a weight is drawn up again and again with the same set of muscles, using the finger, or the forearm, perhaps, and the operation is recorded by a stylus which traces a line on a smoked drum. Fig. 76 is a graphic record of fatigue of the

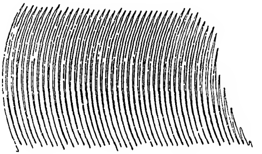


FIG. 76. GRAPHIC RECORD OF FATIGUE [1]

forearm in pulling up a weight and letting it down at the rate of one pull-up a second. The complete movement continues for some time, and then very rapidly the muscles become fatigued, with the result that the subject is absolutely unable to pull up the weight at all until after a period of rest. Carbon dioxide and other waste products which clog the muscles have to be washed away by the blood stream.

The same experiment can be performed by the use of a muscle taken from some animal and stimulated by an electric current. After a time it will cease to contract, until it is rinsed out in a weak saline solution. However, studies of tired and of rested animals have shown that the nerve cell bodies themselves are actually depleted and reduced in size, following a period of long-sustained activity. Thus fatigue affects not only the muscles but also the nerves; rest, sleep, and nourishment are the conditions of recuperation.

Mental fatigue. What is called mental fatigue is largely muscular and neural fatigue. If a person works long at a task, the muscles that support him in his chair and hold up his head become weakened, as do the complicated muscles which control the movements and adjustment of his eyes.

Then, too, the pleasantness or unpleasantness of the task enters in: one seems to tire more quickly when he is doing something he doesn't want to do than when he is exerting himself just as much and enjoying it. Monotonous routine tasks are repellent to many, particularly to more intelligent people, and their feelings are often interpreted as fatigue, though in some cases they may actually be doing the tasks as efficiently as ever.

One experimenter[2] worked at multiplying four-place numbers mentally twelve hours a day for four days; and while at the end of that period her efficiency was reduced about half, she yet did not reach a point where she couldn't multiply at all. There was no mental exhaustion comparable with the physical exhaustion of a fatigued muscle. If she had continued the work for a longer period each day and for several days more, nervous exhaustion would probably have been reached with the usual stages of depression, exhilaration, and collapse.

Distributed practice. Continuously performing the same task results in a lowered efficiency of performance (see Fig. 77). It is therefore necessary to introduce intervals of rest or of a change of activity. In memory experiments, distributed

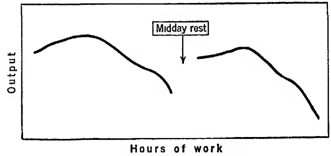


FIG. 77. THE DIURNAL WORK CURVE[3]

repetitions were found to be more efficient than massed learning. One must allow for recuperation not only in physical exercise, but in other activities as well. The introduction of "class periods" in the time schedule of the school takes care of the matter in a rough way. But within any one period, the necessity of such intervals must also be recognized. In the case of individual study, while absorption in a task is desirable, occasional breaks or interruptions may be helpful if they are not too much prolonged.

2. HEALTH FACTORS IN LEARNING

Rest and sleep. While the human body is capable of considerable strain for short periods of time, lack of sleep makes its harmful influence felt in various ways. The general rule which the majority need to follow to maintain a healthful bodily condition is to sleep regularly for approximately eight hours each night. Some require more than eight hours, and apparently some can maintain their efficiency on less. An adult can discover for himself what his needs are, and not force himself beyond his normal capacity except when it is absolutely necessary. Younger children of school age, as a rule, need from ten to twelve hours of sleep a night.

Rest is basically a change of behavior which promotes better circulation. It may be taken by lying down and often should be, particularly after convalescence from disease, or when suffering from minor ailments. Active people dislike going to bed if they are not really ill, but it is usually wiser to surrender graciously than to try to combat an illness by disregarding it.

The following symptoms[4] have been listed as indications of a need for rest and a less strenuous tempo:

[4] W. F. Book, *Learning How to Study and Work Effectively.* Ginn & Co.

1. General symptoms of chronic or pathological fatigue:
   a. Morning tiredness when regular and prolonged.
   b. Tendency to worry over little and insignificant things.
   c. Presence and persistence of insistent ideas.
   d. Inability to assume ordinary business duties without extreme worry or with the usual success.
2. Mental effects of fatigue:
   a. Lack of power of sustained attention.
   b. Failure of memory.
   c. Impairment of power of accurate thinking.
   d. Loss of muscular precision — very noticeable in singing, in playing the violin, and in all work requiring fine muscular adjustment.
   e. Loss of vocabulary — poverty of association, etc.
   f. General feeling of unrest and uneasiness.
3. Moral effects:
   a. Greater liability to outbursts of passion.
   b. General loss of mental control and power to resist temptation; for example, dismissing servants with slight provocation or without cause. Friends going on a trip often have a quarrel in the afternoon because both of them are too tired to react normally under a strain.

The studies of teaching load show that children in large classes learn as much as children in small classes, but the amount of exhaustion of the teachers of large classes is not measured. Thus far, no scientific evidence of exhaustion or added strain is available except in the form of subjective reports of teachers. It seems probable that such reports have some validity, however; and if they have, one would expect that an unwholesome atmosphere would develop in large classes and overcrowded schoolrooms.

Diet and exercise. Most of the common knowledge about diet is false. But modern medical science working in the field of allergy, as it is called, has shown that certain people are sensitized to some foods as they may be to the pollens that

cause hay fever. In the case of foods, however, the resulting symptoms are illusive because the weakened bodily condition produced by eating them allows other pathological factors to operate. In allergic cases, asthma, colds, headaches, hives and other skin afflictions, and nervous symptoms as well as digestive upsets are often brought on by such supposedly healthful foods as milk, bread, eggs, and tomatoes.

Almost as many fallacious beliefs are held about exercise as about diet. Exercise is primarily a form of rest and enjoyment. When indulged in too rigorously, particularly after a period of little physical activity, it is distinctly harmful. There is the danger of strain in the muscles, tendons, vertebrae, and heart, and the results may make themselves felt at once, or they may produce a weakened condition that encourages any number of diseases years later. The excessive exercise of commercialized scholastic sport is quite as apt to be harmful as beneficial to pupils in their school work and life activities.

Physical handicaps. Since visual defects may go unnoticed, and may produce symptoms which seem to have no connection with eye strain, a general checking of vision occasionally is desirable not only for school pupils but for people of any age. Beyond this the important thing in the care of the eyes in reading or writing is an even illumination without shadows or glare.

Attention should likewise be given to decayed teeth and to diseased tonsils and adenoids. Any of these conditions causing what is known as focal infections can produce enough poison to sap the vitality of the strongest. The better schools provide for medical examinations which aim to discover such conditions; but many children are allowed to combat their physical handicaps all unknowing, and their failures are often punished by lower marks or perhaps by low ratings for citizenship.

Effect of drugs. A number of experiments have been performed in the attempt to discover what are the psychological effects of the use of alcohol, nicotine, and caffeine. The method employed is to administer moderate amounts to subjects and then measure their performance in such tasks as speed of tapping, crossing out letters, adding and multiplying, tests of the memory span, steadiness, memorizing, and reaction time.

The differences between the experimental and control groups in all cases are comparatively slight, and must be interpreted in terms of the experimental situations. The immediate effect on performance in the case of alcohol is an accelerated pulse rate and a reduced efficiency in the experimental tasks, the extent varying directly with the size of the dose. In the case of small doses the effect practically if not entirely disappears within three hours. Larger doses show markedly harmful effects on performance.

Nicotine produces slight and irregular differences between the experimental and control groups, sometimes one group showing superiority and sometimes the other In general it has a temporary, mildly stimulating effect on the heart. Caffeine produces a stimulating effect and in small doses a slight improvement in test performance, but in larger doses (equivalent to two or three cups of coffee) an impairment of efficiency.

These experiments, performed on adults, for short periods of time, however, do not permit inferences concerning the effects on juveniles, nor concerning the long-time effect of continued use. The situation is further complicated by the fact that some people are sensitized to some of these substances; hence for such individuals their use is distinctly harmful.

Emotion and aspiration level. Emotional excitement and worry are detrimental to efficient learning largely because of their physiological action through the autonomic nervous

system, and also because of their distracting influence. In the latter case it is obvious that when one is worrying about some thwarting experience, past or future, perhaps indulging in phantasies with respect to it, he is not actually engaged in doing his immediate task.

Similarly, if his level of aspiration is higher than his time or abilities warrant, he is doomed to disappointment and may worry about it, or may spend the time in compensatory activities (Chapters III and IV). The sensible thing to do is to adjust matters as intelligently as one can and then voluntarily attend to the work at hand. Some have found that going through the motions of starting, even though the initial performances are unsatisfactory and have to be done over, is an effective way of combating emotional distraction factors.

3. ENVIRONMENTAL FACTORS

Room conditions. In addition to health factors, environmental influences are likewise important in effective learning. Proper warmth and ventilation, for example, though they are related to matters of hygiene, are important also because their neglect may result in the would-be student's becoming drowsy, or being distracted from his task on account of bodily discomfort. Fresh air and a temperature of 68 to 70 degrees Fahrenheit are usually recommended.

Sensory distractions. Loud noises, or other intense stimuli, and sudden change have been spoken of as prepotent factors in attracting attention (Chapter IX). Other individuals conversing in the room where one is studying supply these conditions, and more, though how to get rid of them may be a problem. One can, as a rule, eliminate mechanical stimuli or become adapted to them; but social distractions cannot be handled so easily. Some people report that conversation and

radio programs do not distract them from their work, that they even are influences conducive to better concentration. This is extremely dubious, though they may find more enjoyment during study under these conditions.

Social attitudes. A more elusive factor is the attitude of one's companions toward study — or toward any of one's objectives or set of values. It seems probable, however, that such attitudes are of great importance, and that a pupil who associates with those who belittle academic work and scholastic success will find it hard to maintain his determination to work ahead to the goal of his best achievement. The solution here apparently lies in a wise choice of friends and associates and the maintenance (if one is old enough) of one's own set of values in spite of contrary social influences.

4. EDUCATIONAL GUIDANCE

Interests and abilities. People are apt to work more uninterruptedly at tasks in which they have some interest and ability Though these are not the only criteria by which to judge the suitability of a course of study, nevertheless methods and curricula have been profoundly influenced by them. Worthwhile activities in which pupils have an interest and sufficient ability to perform them are constantly being substituted for traditional curricular offerings. Methods are sought which may arouse a modicum of interest, at least for the time being. The adaptation of work materials to abilities through pupil classification devices (Chapters V–VII) and individualized instruction techniques has done much to make learning more effective as well as to avoid the distraction of punishment and other forms of compulsion, and the arousal of responses of evasion and escape (Chapter IV).

The vocational objective. Other things being equal, the school

task which bears a clear relation to getting and holding a job ensures fairly conscientious and effective learning. But the relation must be very clear and very close. A vocational skill is rarely developed beyond the point of actual need; and in preparatory study the way that principles and techniques are to be applied is so difficult to make clear that in most technical and professional schools periods of study are interspersed with actual practice on the job.

The avocational objective. What has been said concerning the effect of a vocational objective in promoting more effective learning is also true of avocational objectives, except that there is usually a more immediate and direct interest in the activities of the latter and in the learning connected with them. Hence, in any school task, if a relationship to these objectives is demonstrated, more effective learning and study is likely to result.

5. TECHNIQUES OF STUDY

"*How to Study.*" Countless articles and many volumes have been written on how to study.[5] Many of the suggestions one finds have little basis in scientific findings, and many of them are not used by some very successful students. However, they have most of them been believed to be helpful in certain cases, and so they might conceivably be helpful in others. The suggestions made thus far concerning health factors and environmental conditions in learning and concerning the importance of educational guidance in respect to interests, abilities, and objectives apply to study and to other activities as well. Others apply rather specifically to the reading and study of written materials primarily in the school situation.

Time schedule. Many find that a rather definite schedule for

study is very helpful — a schedule as rigid as that of their class appointments. This is probably quite essential on the elementary and to a considerable extent on the secondary level. Some college students are temperamentally opposed to it, but many who do not like the idea of being bound down to certain work at certain times find that such a schedule keeps them from being regularly behindhand and avoids the rush and cramming of the pre-examination review period. Such an apportionment of one's time is not just a school device, but is necessary in all professional work.

Reading speed. The oral method of instruction, together with the necessity for the slow reading and study of compressed textbook materials, is probably largely responsible for the fact that many people read much more slowly than they need to. Whispering and lip movements while reading silently are clear indicators of vocalization, which slows the process, since eyes and thought can proceed more rapidly without being thus held back, at least in the case of ordinary prose at the individual's level of comprehension. As regards reading, the rule for more efficient study is to increase the speed as much as possible while still comprehending what is read.

Relative values. Some passages may be skimmed, some need more careful perusal, while some demand rereading to comprehend the meaning and the implications. Obviously some sentences are of primary importance in that they state the point the author is making, while others are subordinate to it, serving to clarify, illustrate, and develop it. Practice is often needed to be able to distinguish these, and various simple techniques are employed to make the main points stand out. Italic and bold-face type and capital letters for this purpose appear in textbooks, while students underline important passages or outline their chapters, or they take notes to emphasize and record significant items.

Such phrases as "for example," "by way of illustration," "a case in point," and also, "the conditions responsible for," and "certain important consequences may be traced," as well as a consideration of conflicting opinions, are sure to indicate subordinate points which develop some main theme.

Another help in getting the meaning from a somewhat difficult passage is to read *critically*. If one compares what he does comprehend with what he has read elsewhere, and with his own experience in similar situations, and questions the validity of the cases or arguments cited, or their logic or applicability, he is certain to find that the passage has more meaning for him than he realized. Such critical reading has an added advantage in that it accustoms the individual to detect fallacies and misstatements, which he will meet all his life, not only in advertising, but also in news items and even in books. He learns to ask himself why the writer wishes to get this particular idea across, and what political or sectarian grouping he represents when he tries to support some facts and explain away others.

Applying the principles of learning. Besides the methods and techniques thus far considered there are many others which grow directly or indirectly out of the major principles or laws of learning. These are here reviewed and some of the applications to effective study indicated.

6. PRINCIPLES OF LEARNING

Contiguity. Parts of a recurring stimulus situation will come to arouse the same response that other parts or the whole situation formerly aroused.

This is the principle of contiguity as it applies to the association of ideas, associative shifting, and the conditioning of reflexes. Variations naturally occur according to the nature

of the phenomena, but so far as study is concerned, one cannot expect to learn skills or acquire knowledge unless a different (substitute) response is made to familiar stimuli; or unless habitual responses are made to substitute stimuli which did not formerly call them forth.

It is known that all parts of contiguous experiences are not recalled with equal ease. Like the alphabet, they tend to be remembered and repeated *in the order in which they were learned*, and various logical relationships usually have a firmer connection than most chance events occurring at the same time. Why some things seem to "*belong*" together more than others it is difficult to say; but that they do, so far as the ability to recall them is concerned, is well established. Such patterns of objects, words, or ideas exist in part because of their nature, just as the base belongs to the triangle, or perhaps because they have always been experienced together

Exercise. Use tends to increase and disuse to decrease the probability of the recurrence of a response.

In experimentally controlled situations in which all factors are controlled, exercise alone seems powerless to promote learning or increase retention; but operating under normal conditions it is usually a necessary factor. Emotional *intensity* aroused by a situation may make repetitions unnecessary for permanent retention. But complicated motor skills require practice, and verbal material drill in their acquisition. For the latter, to ensure more complete recall *overlearning* is necessary, as well as spaced relearning periods or *reviews*.

Effect. Rewarded responses tend to be repeated, and under certain conditions punished responses tend to be eliminated.

There are many kinds of rewards and punishments which have different effects on different individuals. An anticipated reward serves as an incentive, and a punishment as a deterrent (Chapter II), and the valencies of these two balancing factors

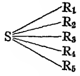
in large measure determine the direction of an individual's effort. If the situation is set in such a way that there are only two possibilities of action, the punishment of one becomes a reward for the other.

Knowledge of success and failure in respect to individual responses and also in relation to the extent and direction of one's progress is a consequence of great importance in increasing the effectiveness of learning. A learner's success or failure may be quite evident to him, as in many sports; his teacher may tell him orally or by means of a mark, as in language usage or in history; or he may find it out for himself, as in the workshop or in the solution of practical problems. A curve showing his progress by charting his performance at regular intervals may be advantageously employed, instead of the coarser gradations of the usual marking system.

A rewarded response is more apt to be repeated than one which is not thus singled out; though when there are many possibilities, a response which is punished, or at least one which the pupil has been told is wrong, may be repeated too, presumably because of the emphasis thus given it. The *relevance* [6] of a reward to the wants of the individual is apt to increase its effectiveness, though an irrelevant reward may be quite effective, or it may become relevant by use or, like money, for its symbolic value.

Multiple response and multiple causation. The three principles thus far discussed, contiguity, exercise, and effect, may be considered the basic laws of learning. They involve, however, certain characteristics of behavior which are fundamental to both human and animal activity. One of these is multiple response, which may be stated as follows: *To any one stimulus situation, an organism may respond in a number of different ways.* This number varies widely from a very few in the case of the lowest forms of animal life (approach and avoidance)

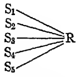
to an infinite number in man. (See Fig. 58 and diagram below.)



Multiple Response

For example, to a page in a textbook, a student may respond by reading it, underlining the main points, crossing out all the *e*'s, drawing pictures in the margin, and so on.

Another characteristic of behavior is multiple causation: *Any one of a number of separate stimulus situations may produce the same response.* A person might run away from a number of things, or he might look at or become interested in a page



Multiple Causation

in a textbook, a speech, a ball game, or a fire, and so on. This flexibility of response and of stimulation creates the occasion for learning.

Prepotency or selection. The individual responds to only a limited number of stimuli at a time out of the large number to which he might respond. That is, he responds to parts of a total situation. While it is impossible to predict accurately the stimuli to which he will respond, nevertheless certain factors limit his choice. One of these is *sensory prepotency* — the intense, changing, contrasting, or familiar stimulus, which causes a pupil or anyone else to attend to certain things and not to others.

Another factor is *analogy*: the individual responds to parts of one situation which are similar or analogous to the parts of other situations to which he has already learned to respond. He does what he can on the basis of the experience that he has had, even though other parts of the new situation might better be responded to.

A third factor is *relationship*. The individual may respond to the larger of two objects, the brighter of two lights, the more important of two points. Learning often involves an improvement in one's ability to select the parts of a situation to which to respond in view of certain desired ends.

Set or attitude. Response is made to certain parts of a situation rather than others according to the set or attitude (or wants or desires) of the individual.

The teacher says, "Read the page and discuss what you have read," or one turns to watch the street parade if not engaged in more important business. The directions given, the goal sought, the experience of the individual, his mood at the moment — all these and many more subjective factors determine his set or attitude and hence the stimuli to which response will be made.

The part of the situation responded to is thus largely responsible for the response that is made to the situation, though any part may, of course, be responded to in any one of a number of different ways. Many of these ways of responding, as well as the prepotency of the several stimuli, and also the set or attitude, are at least partially under the control of the individual in the process of his own learning. They are also to no small degree under the control of the teacher, who is likewise often the supervisor or director of the study of school pupils. The matter is complicated, but ignorance is no simplification.

Identifiability and availability. Learning is more efficient

when the stimuli to which the learner is to respond are easily identifiable, and the required responses are available.

If the stimuli are too complex for a child to distinguish at his stage of development, or the responses too difficult for him to make, it is better to wait until he matures sufficiently to be ready for the instruction, instead of trying to force the learning process. Of course, much instruction consists in helping the learner to identify stimuli, and to make responses available.

Individuation. Parts of response activities are modified and perfected in relation to the total activity.

It might be argued that such parts as the stanzas of a poem or leg movements in swimming are learned separately and then *integrated*, that is, fitted together, like bricks in a wall. In the case of the growth of tissues or the maturing of physical or mental functions, however, what seems to take place is an organic development of the parts in relation to the whole. They develop as they do because they are parts of a larger movement or process, and in this development they gradually become individuated and distinguishable as distinct units.

Constructive synthesis. Parts of experience are abstracted and combined in new ways to form a solution or a hypothesis.

The length of the stick, the distance to the banana, and the muscular activity of the chimpanzee combine or synthesize in a time-space pattern to solve his food problem for him — at least temporarily. If, however, one of them is missing, or if the strength of the stick or its possibilities for poking or climbing get into the pattern instead, he will not solve that problem. The keeper may even hand the stick to the ape and point to the banana without avail. Similarly, suspended strings too far apart to reach are tied by human subjects if a weight is brought into the pattern by hanging it on one string to make a pendulum.

The rearrangement of elements of experience into new

patterns seems to be a somewhat chance affair for any one individual. A whole experience may be formally analyzed or broken up into parts, and the parts combined in endless ways which may bring the solution no nearer. However, the rearranging may take place almost kaleidoscopically and before one is aware of it. The new patterns (hypotheses, solutions) may then be tried out, rejected, or accepted.

Teacher's suggestions are helpful only when they give the right *direction* to the pupil's patterns of thinking; otherwise they are meaningless or confusing. "Remember what we learned to do yesterday," or "What do you already know about parallel lines?" or "What would your father say?" are samples of such dubious directions. Instruction can be helpful if the suggestions are appropriate to the situation, however, and it can also aid pupils considerably in checking the correctness or desirability of their tentative solutions.

Creative synthesis. Parts of experience are combined in new ways to form a pattern having an emotional and empathic appeal. The psychological processes involved in aesthetic creation, though similar to reflective thinking, are nevertheless very obscure. But analysis of works of art has shown that the elements are traceable to specific sources, though the form which they assume is new and its appeal is emotional and empathic. Children develop creative ability with opportunity, encouragement, and kindly criticism. Detailed instruction in techniques if given too early may discourage expression.

Summary. The efficiency of a person, child, or adult may be assumed to be less than it might be. The quality or quantity of his mental output may be improved, or the time he takes reduced, or both. Increasing efficiency involves practically all the psychological processes to a greater or less degree. A number of factors are operative, for example, fatigue, health, environmental conditions, abilities and interests, special

techniques of study, and the applications of the principles of learning.

QUESTIONS

1. Make a check list of the suggestions for effective study given in this chapter. Rate your study conditions and study habits on it as good, average, or poor.
2. What suggestions do you consider the most helpful to you?
3. Make a time schedule of your activities for a more-or-less typical week. How many hours are spent in ways which are neither enjoyable nor profitable? How many hours, on the average, are given to study each day? How many to each subject per week?
4. Set up a schedule for the study of the subjects you are now taking, and adhere to it rigidly for a trial week. Report on the advantages, and on any modifications that would seem desirable.
5. How can you develop effective study habits in the children you are planning to teach? What other methods than talking will be necessary?
6. Illustrate the operation of each of the principles of learning listed in the study of some one school subject or activity.

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In *Readings in Psychology*, chap. XXIII, there is a detailed presentation of some of the conditions of efficient work Other references will be found following the chapters of the text dealing with the aspects of learning which are reviewed in this chapter.

CHAPTER XV

TRANSFER AND THE SCHOOL SUBJECTS

The spread of learning. It is one thing to retain facts and skills once acquired and be able to repeat them when requested to do so. It is quite another to be able to use or apply them in the varied situations and on the different occasions when they might be appropriate.

One sometimes hears a disparaging reference to "mere knowledge" or "mere facts," because such acquisitions do not always function in actual situations. Can one use the chemistry he has learned in such a way as to make wise judgments in matters of diet and health, his arithmetic to keep household accounts and estimate areas and costs, his Latin to aid his English vocabulary, and his political science to help direct the affairs of local government?

It is all too clear that much that was supposed to be learned in school had no such functional value. It was knowledge for knowledge's sake, or else a preparation for more advanced courses. When the special knowledge or skill was more or less completely mastered, a mark was given and the school's work was done. Examples of such knowledge and skill are numerous. They include a number of curricular practices which are rapidly becoming obsolete like finding the cube root, figuring compound interest, learning to spell words that have no meaning for the pupil, and diagraming sentences. They include also a large number which still remain in the curriculum, such as factoring in algebra, demonstration in geometry, reading Latin passages, and reciting scientific facts and experiments — things which the great majority of children will have absolutely no use for once they get out of school.

I. FORMAL DISCIPLINE

The doctrine of formal discipline. To support the retention of such curricular materials in the schools a very insidious contention has been urged, one which has occupied the attention of psychological investigators on and off for several decades. This is the doctrine of formal discipline, which may be stated as follows: The rigorous pursuit of knowledge in certain fields is of value to the individual in other ways quite apart from any advantage he may derive from the actual knowledge obtained. This position is enunciated in the following quotations:[1]

> The critical study of language, for example, calls into exercise mental powers that are much used even in the mastery of botany, zoology, and other natural sciences.

> Some arithmetical exercises are admittedly and necessarily mechanical, but "problems" are among the finest school exercises for training the judging faculty.

> You can hardly imagine a subject, essentially uninteresting, which would not reward plodding work with a similar result — with substantial ignorance of the matter studied, but with increasingly and lastingly muscular power of voluntary attention.

Historically, the development of the doctrine is very interesting. The study of Latin, which is often mentioned as one having considerable "disciplinary value," was pursued by scholars during the Middle Ages for the reason that all the learned books were written in Latin. After local dialects developed sufficiently to compete with this universal language of scholarship, translations of classical writings appeared in the various European languages, and the need for Latin waned. And then it was that the argument for its disciplinary value gathered strength.

Similarly, with the decline of scholasticism and the rise of a scientific interest in natural phenomena, a knowledge of mathematics and natural science became the vogue. But when the social sciences began to draw their adherents, natural science was thrown back to the same line of secondary defense, the disciplinary value.

Faculty psychology. The case for formal discipline, that is, for the belief that a general value is to be derived from the various school "disciplines" apart from any specific knowledge that might accrue, was supported by what is known as faculty psychology. The traces of this psychological doctrine are to be found even today in the idioms of the English language in such phrases as "the use of reasoning power," or the "faculty of memory," or "with all his faculties alert." According to faculty psychology, the mind is made up of separate abilities or faculties. What the mind *does* thus depends upon what the mind *has*, that is, upon its parts. The shift is therefore from the verb to the noun form, from remembering to memory, from imagining to a faculty of imagination, and so on. One reasons, so one has a reasoning power; one observes, so one has the power of observation, one perceives, so one has a faculty of perception.

The three major faculties of the mind have been listed as *cognition* or knowing, *affection* or feeling, and *conation* or willing. Each of these was then divided into various smaller faculties; in the case of cognition, sensation, perception, judgment, imagination, reasoning, and so on. Such classifications are convenient to use in delineating the different kinds of things the mind can do. But the inferences to be drawn from the faculty point of view may lead one on the wrong track, and they are too important to be neglected. If one has a faculty of reasoning or observation or perception or memory, one might conceivably wish to do something with it, say to

strengthen it, without bothering to disturb the other faculties with which one might be well satisfied. The analogy of the muscle and its strengthening was used frequently.

If one wished a better memory, he should practice remembering; if better judgment, he should practice judging — no matter what, so long as he remembered (or judged) something! The school subjects in which these abilities were called into play thus became a set of mental setting-up exercises to make one mentally fit to cope with whatever might come along in the course of the day's or life's work.

The *reductio ad absurdum* was reached in the development of phrenology (Chapter V) If there are such things as mental faculties, they must supposedly be somewhere, so they were located at various convenient points on the surface of the brain where they have remained ever since, according to the phrenological charts.

Formal discipline a half truth. The basic fallacy underlying the doctrine of formal discipline lies in the assumption of the existence of the faculties themselves as separate and independently operating parts of mental activity. If this is fallacious, so too is the corollary that the exercise of one of them in one situation makes it more effective in any other situations where it might be used.

Common knowledge suggests many cases in which this fallacy is obvious. A trained biologist may observe animal forms under a microscope which a hunter would not see, whereas the hunter would espy game which would not be noticed by the biologist. The historian can remember dates and the actor his lines, but both may forget telephone numbers. The physicist may follow a reasoning process through to a major scientific discovery, while his way of dealing with his own children may exhibit the wildest unreason. A college professor who in his own field is wont to make judgments only on the

basis of sufficient evidence, will blithely recommend educational policies involving all kinds of children of all ages and degrees of mental capacity on the basis of his own limited childhood experiences. Apparently there are plenty of cases in which the training of a mental "faculty" in one field does not guarantee the excellence of that same faculty in another.

On the other hand, the school cannot be expected to provide every child with all the specific knowledge and skill which he will later need. It is reasonable to assume that what one has learned has some influence in new situations. Illustrations could be multiplied. Those who can play two or three musical instruments can usually learn to play others more easily. Lawyers, or clergymen, or politicians as a rule attack social problems from their respective professional points of view, and so on. Apparently certain general habits, skills, and attitudes function more or less satisfactorily in new and different situations. Can educators assume that what is learned in school will be of any use in developing the powers of the individual so that he will be more capable of meeting new situations for having received the instruction?

Very little is to be gained from opinion and authority. It would be better to set up an impartial investigation to find out, for example, whether memory training results in more rapid memorizing, whether the study of Latin improves one's English vocabulary, and so on; and if so, whether it does so in sufficient amount to be practical, and whether the method of teaching is an influential factor.

At any rate, the use of the term *transfer of training* clarifies the situation so that instead of arguing the acceptance or rejection of the doctrine of formal discipline as a whole, one may investigate the extent of transfer. Indeed, many investigations of this nature have been made, and all of them have shown so little transfer effect that the so-called disciplinary

studies have tended to fall into disrepute. But before discussing the extent of transfer in school subjects let us first consider what takes place in the case of such mental functions as remembering, perceiving, judging, and the like.

2. TRANSFER IN MENTAL FUNCTIONS

James on memory. The first transfer experiment was performed by William James,[2] in 1890; and it didn't come out the way he expected it would. He first memorized 158 lines of Victor Hugo's poem, *Satyr*, to get his memorization rate before training. This took him $131\frac{5}{6}$ minutes, over a period of eight days. Then, to "train his memory" he worked twenty minutes a day for thirty-eight days learning the first book of Milton's *Paradise Lost.* But when he went back to *Satyr*, it took him $151\frac{1}{2}$ minutes to memorize another 158 lines — twenty minutes longer than it took him before the training! Repetitions of the experiment[3] have shown sometimes a little gain and sometimes a little loss.

Later experiments have improved the technique by *shortening the initial test period* to exclude training during it, and by employing a *control group.* The controls take the initial test and the final test, but *not* the training. If, then, they improve less than the experimental group, it is concluded that the amount of the difference is a measure of the transfer effect. So the amount of improvement made by the controls is subtracted from that of the experimental group, the difference being called the *residual gain.*

Other memory-training experiments, which have employed poetry, prose, and nonsense syllables, have as a rule resulted in a rather small residual gain, usually about five to ten per cent of the amount of time taken for the first memorizing.

Thorndike and Woodworth on perception. Thorndike, work-

ing with Woodworth at Columbia in 1901, set up an experiment[4] in the transfer of training in the field of perception, eleven years after James's experiment in memory. They found that subjects who had been trained to estimate the size of small rectangles could estimate the size of large rectangles or similar areas of different shapes from about a third to a half better, showing some transfer. This was also the result with heavy weights when the subjects had been trained to estimate small weights. But subjects who had improved 25 per cent by training in their ability to estimate the length of lines from half an inch to an inch and a half long showed no improvement in estimating lines six to twelve inches long. Their training on the short lines did not help with the longer ones. Similar results have been reported by other experimenters in the field of perception who have used such materials as the cancellation of letters and words, discrimination of colors and sounds, and so on.

Judd on sensory-motor skill. Judd reports an experiment[5] performed under his direction in which the subjects aimed darts at a target under water. When they had acquired considerable skill, the depth of the water was changed. Some of the subjects then tried to hit it but were as badly off as when they started. The rest of the subjects, however, were given instruction in refraction, and their skill, after the position of the target was changed, was still considerable. In this case, the previous training transferred to the new situation only when the subjects had instruction in the general theory relating to what they were trying to do.

If the direct training of a mental function is of such slight value when the situation is altered slightly, one becomes somewhat dubious about the transfer effect of the diverse kinds of training found in a school subject and the extent to which it will transfer to other school subjects or function in life situa-

tions. And the research studies which have been made tend to deepen one's distrust.

3. TRANSFER IN SCHOOL SUBJECTS

Pupil selection. If those pupils who study Latin do better in English, it is often assumed that the Latin is the reason for their superiority. As well say that the sun rises because the rooster crows! It has been shown[6] that those who later studied Latin did better work in English than those who did not, before either had studied any Latin at all. Furthermore, those who later studied Latin for four years were better in English than those who later studied it for only two years, before either had enrolled in their first Latin course. In other words, as a rule those who elect Latin in high school with a view to going on to college are already through inheritance and training more facile in the use of the mother tongue than those who do not elect it. The study of Latin, and also of mathematics, physics, and chemistry, serves as an intelligence test. One will have to look further for exact information as to their actual influence.

Identical elements. In the experiments on mental functions, it has been shown that the more alike the training given is to the ability to which it is supposed to transfer, the greater the transfer. This fact has led to the doctrine that such transfer as is found takes place through the agency of the elements in the two situations which are identical. Thorndike, who has long supported this doctrine, states it in the following words:[7]

> A change in one function alters any other only in so far as the two functions have as factors identical elements.... To take a concrete example, improvement in addition will alter one's ability in multiplication because addition is absolutely identical with a part of multiplication and because certain other processes, e.g., eye movements and the inhibition of all

save arithmetical impulses, are in part common to the two functions.

Chief amongst such identical elements of practical importance in education are associations including ideas about aims and ideas of method and general principles, and associations involving elementary facts of experience such as length, color, number, which are repeated again and again in differing combinations.

Language study. Studies have shown[8] that Latin students do a little better on vocabulary tests containing words of Latin origin than do pupils of equal intelligence who have not studied Latin; but they are no better than the others on words derived from other sources. Latin students can spell Latin derivatives a little better, though they are slightly if at all superior on French derivatives. They know more about the Roman history relating to Caesar's Gallic War and Cicero's orations than do those who have not belabored these classics; but beyond this their knowledge is no better than that of their non-Latin studying classmates.

Formal English grammar has elements in common with the grammar of foreign languages and hence "transfers" to them, but it has little or no relation to English composition or usage, or to the interpretation of English literature. Transfer of training from the fundamental processes in arithmetic to arithmetical reasoning is non-existent. The ability to observe and describe botanical specimens, as would be expected, transfers to some extent to the description of other botanical specimens, but no studies have been made of the transference to the description of rock layers, for instance, or baseball games.

Transfer and gain on intelligence tests. A comprehensive study under Thorndike's direction[9] aimed to discover whether pupils who took certain school subjects or groups of subjects tended to gain more on intelligence tests than those who took other

subjects. This is the largest research gun that has been fired at the doctrine of formal discipline in that, including both parts of the inquiry, it involved the school programs and intelligence scores of nearly fourteen thousand pupils. If pupils who take such subjects as Latin, algebra, and so on really build up a "general power" that can be turned on in various situations, this general power should be reflected in their scores on the situations presented on intelligence examinations.

The examinations used were the so-called I.E.R. Tests of Selective and Rational Thinking, Generalization, and Organization. The pupils were divided into groups according to the subjects they took, to discover whether those who studied certain subjects gained more on the tests than those who studied other subjects. The authors have stated some of their conclusions as follows:

> The general results were that the amount of gain bore only a slight relation to the studies taken. The bright gained more than the dull, and the white pupils more than the colored; but pupils who took, say, Latin, geometry, English, and history gained little more than pupils of equal intelligence who took arithmetic or bookkeeping, cooking or sewing, English, and history (p. 377).

> The superiority of Latin over French in producing gain in score in the tests of intelligence is approximately zero (p. 378).

> The influence of taking one study rather than another upon the gain in intellectual power as measured by the test used was very small.... Certain studies *select* the abler intellects rather energetically. The pupil who takes Latin or French averages many points higher in initial score than the pupil who takes [any study of about average influence] or nothing in place of Latin or French. The same is true to a less degree of algebra, geometry and trigonometry, and of the physical sciences. The reverse is true of cooking, sewing, stenography and typewriting, and of bookkeeping.

> They [the two parts of the research] agree in disagreeing with the traditional doctrine that Latin, algebra, and geometry are the prime disciplinary subjects of the high school. The average for Latin, etc., and algebra, etc., is lower than the value for physical science in both series for persons of the same sex and initial ability (p. 382).

4. CONDITIONS OF TRANSFER

Cross-education. As may be suspected from the nature of the experimental studies reported, the term *transfer of training*, though an improvement over "formal discipline," itself needs to be carefully interpreted. In one sense cross-education, or the effect of a skill acquired by one hand (or one side of the body) upon its performance by the other is a kind of transfer. One may discover, for example, that some of the effect of practice one has in tracing a star in a mirror with the right hand "transfers" to the left hand.

Negative transfer. Also, the skill which one has acquired in playing baseball transfers to other games, like golf or tennis. Here, however, there may be some negative transfer. While the general bodily vigor gained in one form of physical exercise may stand one in good stead in another, the particular way of holding the baseball bat may actually interfere with the proper manipulation of a golf club or a tennis racquet. Negative transfer or *interference* is a common experience in motor skills, and also in mental abilities. Two foreign languages are not started the same year because the learning of one, instead of facilitating one's progress in the other, actually leads to confusion.

Automatic transfer. Whether negative or positive, the transfer may be automatic, going on without any voluntary direction by the subject, as in the examples just cited, or in the use of habits of thinking developed, for example, in

theological or legal training when turned to problems of social welfare or child training. The person just thinks the way he does without consciously bringing to bear any earlier experience upon the problem in hand. Or he may thoughtfully use his previous training in the new and similar situation.

Response by analogy. If the same response is appropriate for two situations, there must be some similarity between those two situations. They must be alike or even identical in those respects which are important in determining what the response should be.

A towel is very like a flag in many ways, but differences in color, texture, or location serve as a cue for their differing uses. Two flags, however, having the same color and pattern, but differing in size and texture, demand somewhat similar treatment. To discover whether or not a person is capable of responding to the significant elements in the new situation leads one far away from the usual concept of transfer to a consideration of matters of intelligence and judgment and the nature of the thought processes.

Particular or general elements. Clearly, just what things are transferred is thus decidedly open to question. It can be said that the ability to add is transferred to multiplication, but it is just as true to say that there is no transference at all; one merely adds in both cases. It then becomes a question as to whether the person can use what he has learned or can see where there are opportunities for using it. If a child learns the meaning of certain Latin words but does not recognize that they are the basis of certain unfamiliar English words, he will not be able to infer the meaning of the English words.

Judd has developed the idea illustrated by the target experiment and has emphasized the importance of the mastery of a general principle which may then be applied when the occasion arises. If one gains such a thorough understanding of

a principle by observing its operation in a number of particular situations that it is at once recognized as applying to a new situation, intelligent transfer may be expected. Indeed, Thorndike included such generalized formulations in his delineation of identical elements in the passage quoted in Section 3 of this chapter.

In the matter of transfer through generalization, it is important to distinguish between understanding a principle and merely memorizing it. Experience has shown that a rule may be memorized without being applied. Children who can recite prefixes which call for the dative need special practice in using them; and those who state glibly enough that honesty is the best policy may or may not consistently deal honestly with their fellows. This does not mean that generalizations and ideals are of no value, but that they do not insure transfer. It takes place automatically only when the situations are very similar, or when they call out similar responses by analogy. Special thought and experience are necessary when greater differences enter in if the transferred elements are to be employed effectively.

5. INCREASING THE PROBABILITY OF TRANSFER

Breadth of experience. The ideal way to make learning function in different situations is to provide experience and training in the different situations, thus reducing the necessity for transfer. If the meaning of English words is the objective, these can be taught instead of Latin, which seems a reasonable procedure anyway. If the pupil is given practice in judging areas of different sizes, he will not have to depend on a narrow experience with smaller areas to judge larger ones. Similarly, if he has dealings with groups of people in work and in play, and gradually develops desirable social habits, he will not have

to try vainly to transfer the precepts and experiences of a secluded or over-protected childhood to the rough and tumble of the actual world.

It is obvious, however, that the school cannot hope to provide samples of all the motor, sensory, and intellectual situations, individual and social, which a child will meet after leaving school. It is necessary, therefore, to provide him with a wide sampling of such habits and skills, attitudes, and ideals as supposedly will best equip him for the kind of life he will probably lead, and for the kinds of things he will need to do.

Verbalization. There is, then, a real value in rules which can be memorized and applied, whether they be rules of grammar or of etiquette, whether they be principles of government or of ethical conduct. But in the teaching of these verbalized generalizations, it is extremely important that they be arrived at gradually in terms of experiences which the child understands, and that sufficient practice be provided in their application, so that for the time being, at least, reference to the rule is unnecessary. After all, it is the right kind of response in different kinds of situations that is sought as the goal of education, not the ability to recite rules about it.

Intensity. If the things learned in one situation are to be of use later in more or less similar situations, they must be learned with intensity. Actual experience often provides this, and without it other means must be sought to make the learning vivid and bring home the possibility and necessity of its application. Hence a good teacher must have a dynamic personality to enkindle the enthusiasm of the pupils. The things which they experience vicariously through the power of their own imaginings must be well-nigh as real as if they were actually going on.

Prestige. What the teacher says is often as readily accepted by the pupils as the word of the football captain or of a favorite

uncle, or what is heard over the radio, or (at an earlier stage) what "my mamma says." Sometimes it is, instead, something to disregard or even sneer at. The factor of prestige is an elusive one to analyze, but its force is unquestioned. The oft-repeated words of a good teacher ring in a pupil's ears the rest of his life to help and guide him in times of stress and uncertainty. "Yes, but let's get at the facts." "You can get it if you work hard enough at it." "What's given?" "But what would be the consequences?" Such words as these apply in many situations, and may dwarf in their importance most of the facts of the course in which they may have been heard.

Habits of work. Much of the supposed value of the disciplinary subjects, apart from their success in selecting the more able students, seems to arise from the habits of work which they are said to develop. If one learns to be more careful about exact meanings of words from a study of Latin, more precise and accurate from a study of mathematics, and more apt to observe carefully and generalize cautiously from a study of science, then there is abundant reason for the pursuit of these studies on the part of all.

As we have seen, however, there is grave danger that these estimable habits of thought stay confined to the narrow circle of the data within which they are employed. However, habits of work may be developed in the study of a school subject which will be used in other subjects. One very interesting experiment[10] demonstrated this quite clearly.

One hundred and eight college sophomores were divided into three groups: a control, a practice, and a training group. The *control*, as usual, just took the initial and the final tests. The *practice* group took these, and in the time between them memorized materials in the usual method of the transfer experiment. The *training* group spent the same amount of time

between the tests, but part of it was given to memorizing, and part of it to instruction in the technique of memorizing. Six different kinds of materials were used, including poetry, vocabulary, and historical dates, and in every one the residual gain for the training group was much more than it was for either the control or practice groups. The instruction included a demonstration of the following characteristics of efficient learning:

1. Learning by wholes.
2. Use of active self-testing (the method of recall).
3. Use of rhythm and grouping.
4. Attention to meaning and the advantage of picturing or, depending on the individual, otherwise symbolizing the meaning.
5. Mental alertness and concentration.
6. Confidence in ability to memorize.
7. Use of secondary associations.

It would seem, then, that not practice alone, but practice of the right kind is important; and one can train himself, if he knows how, by following such suggestions as these to improve his ways of learning.

Learning versus teaching for transfer. In general, then, it may be said that the best way to learn something is to learn it, and not something else. Every effort should be made to learn efficiently, and by repeated practice or review to retain what is learned as completely and correctly as possible. The significance of what is learned should be recognized, and its implications understood. Opportunities for actual practice in its use should be provided, in situations as nearly like those which may appear later as can be devised.

Verbalized generalizations in the form of rules or principles should be built up rather than imposed, and should be a means rather than the sole end. Furthermore, the desirability of

employing the principle whenever it may be properly applied should be recognized. Thus may the schools increase the probability of transfer, and hence the effectiveness of learning.

Summary. The doctrine of formal discipline, based upon the outgrown faculty psychology, has been recognized as unsatisfactory because it is psychologically unsound and practically ineffective, and because as stated it implies acceptance or rejection. The term "transfer of training" (or "spread of learning") has been employed to avoid these difficulties and to open the way for experiments whose object is to discover the extent to which improvement in one function influences improvement in another.

Experiments in the transfer of training have shown that the amount of transfer varies in relation to a number of factors, namely, the ability of the learner, the complexity of the material learned, the extent of generalizing which takes place, and the recognized identity in or the functional relationship between the materials studied and the situations where they may be applied.

There is no question but that a transfer of learning does take place, negative or positive, sometimes in small and sometimes in large amounts. The educator's task is therefore an engineering enterprise. It consists of presenting materials and calling forth activities in such a way as to insure the maximum amount of transfer in desired directions.

QUESTIONS

1. Define and discuss the relation between faculty psychology, formal discipline, and transfer of training.
2. What is the meaning of the word *formal* as used in the phrase "formal discipline"?
3. How do you account for the discrepancy in the two student attitudes as expressed by the following familiar statements: (1) "The ex-

amination just called for facts," and (2) "He certainly knows his stuff."

4. What do you consider to be the disciplinary value of some subject you have studied? The transfer value? How might the latter have been increased?
5. Distinguish training from disciplinary value in the relation of some one school subject to another. In what sense can it be said there is no such thing as transfer?
6. What is meant by the statement that Latin acts as a means of selection? What other selective agencies might be employed to discover the more able students?
7. In respect to some school subject you are planning to teach indicate (1) the transfer values that might be expected to derive from it, and (2) the means that might be employed to increase the amount of transfer.
8. In what ways does an activity program provide opportunity for transfer?

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CHAPTER XVI

CHILDHOOD AND YOUTH

Growth and development. It is by now quite clear that many complicated psychological processes are going on in an individual at the same time. Such processes as sensing, perceiving, thinking, and feeling, as well as emotion, motor skill, and purposeful activity may all be operating in such a comparatively simple act as writing a letter or playing a game. These processes are not stationary, but our views of them are cross sections, so to speak, of activities continuing in time. Thus experience is not like a photograph so much as it is like a motion picture — one act merging into the next, and so on — from the time of the appearances of the first embryonic reflexes on through the time of birth, infancy, childhood, adolescence, and adulthood, until death.

The various psychological processes operating simultaneously and continuously have been considered in some detail. We shall now note some of the characteristic ways in which they combine at successive periods of growth and development.

1. HEREDITY

Hereditary differences. What a person is, is dependent in part on his experiences, that is, on the responses he has learned to make to his environment, and in part on the bodily structure he has inherited from his forbears. Individual differences due to hereditary causes are, however, extremely hard to isolate because of environmental influences and the difficulties involved in experimentation. Such physical characteristics as stature, and color of the skin, hair, and eyes, and in many

cases intelligence and temperamental factors, are inherited. But given the basic nature, environment and experience can modify it in important ways.

Such phrases as "like father, like son" and "a chip off the old block" point to the well-established fact of family likeness. Though "As the twig is bent, so the tree inclines" indicates the equally well-known environmental influence upon development.

Galton showed that children tend to reach a stature that is between the average for the race and the height of their parents. He also asserted that they inherit half their characteristics from their two parents, half the remainder from their four grandparents, and so on, though he pointed out that these apply to averages and not necessarily to individual cases.

The Mendelian ratio. Gregor Mendel (1822–1884), an Austrian monk, whose researches were not known to the scientific world until 1900, formulated the laws of inheritance from his experiments on garden peas. Work since his day has borne out his conclusions with respect to many traits or characters in plants, domestic animals, and man.

Mendel used the term *dominant* to apply to certain characteristics which are transmitted in one way, and *recessive* to those which are transmitted in another. If we use the tallness of the pea vines to illustrate dominance, and the shortness to illustrate recessiveness, the result of breeding these two characters together is a *hybrid* with the dominant character, that is, tallness. If such hybrids are bred with each other, however, three out of four of the offspring are similar dominant hybrids (tall), but one is recessive (short), like one of the original parents. The recessive continues to breed recessives, and one of the dominants continues to breed dominants. The other two dominants continue to breed according to the same 1:2:1 ratio of their parents — one pure dominant, two hybrid

dominants, and one pure recessive, or three talls to one short.[1]

A few anatomical characteristics have been found to follow the Mendelian ratio — hair and eye color, for example. But this is not the case with such a complicated characteristic as intelligence. The reason for this, in part, is that intelligence is not a "unit character" like the tallness of pea vines or eye color. The genes are the parts of the chromosomes in the sperm and ovum which are supposed to transmit inherited characteristics. And probably many genes in many seemingly chance arrangements serve as carriers of such a trait. The number of such arrangements, following fertilization and cell division, would be very large.

Then too, there are other causes of intelligence differences than inheritance. Encephalitis, for example, or early injuries, may be responsible for an enfeebled mental condition, while environmental influences during childhood undoubtedly are of no little importance.

Growth, of which increasing intelligence is a part, implies a more or less perfect organism in a more or less favorable environment. Both are essential parts of the same process, just as seed and soil are both essential, and if either is poor, an inferior plant will be produced. The schools, however, must accept the pupils' inheritance as it is. There is nothing they can do about it, and very little they can do about the home environment. They can, however, provide as favorable a school environment as may be for the maximum intellectual growth, and to do this requires some knowledge of the hereditary and environmental background of the child.

2. GROWTH

Physical growth. If it were not so common, growth would seem more like the mysterious phenomenon that it really is.

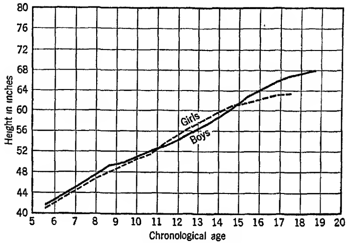


FIG 78. GROWTH CURVES OF HEIGHT[2]

The rate at which it proceeds, as measured by such simple indices as height and weight, has been accurately charted in recent years, not only for groups of children of different ages, but for the same children at successive ages.

The average height shows a fairly gradual increase, the boys being taller than the girls until about the eleventh year. Then, since girls mature earlier, the relation is for a short time reversed, and they are taller than boys until around the fifteenth year. There is, of course, a wide variability at all age levels. The norms, however, do not indicate what one's height *should* be but merely what the average height at different ages *is*.

The rate of ossification of the wrist bones is in some ways a better measure of development than height or the height-weight ratio. The cartilage in the wrists hardens into bone as the child matures, and the process is easily observed by means of the X-ray. Measurements of the cubic capacity of the brain show an increase in the rate of growth at the thir-

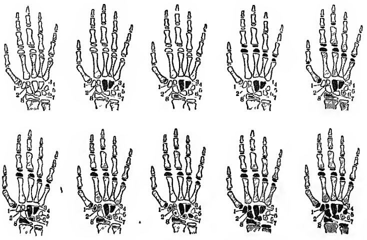


FIG. 79. NORMAL PROGRESS IN THE OSSIFICATION OF THE WRIST BONES FROM BIRTH TO TEN YEARS OF AGE[3]

Upper row: newborn; 4½ months; 1¼ years; 2½ years, 3¼ years.
Lower row: 5 years; 5½ years; 6 years; 7 years, 10 years.
The shaded portion shows the bones of the hand as already formed at birth, and the black shows the ossification after birth. The white portions are not yet ossified.

teenth and fourteenth year. The different organs of the body grow at different rates from that of the body as a whole.[4] The thymus gland, for example, grows very rapidly during childhood, and then shrinks in size, while the gonads grow very slowly until about the fourteenth year and then accelerate rapidly.

3. INFANCY AND EARLY CHILDHOOD

Walking and talking. During the rapid growth of the prenatal months, the bodily organs are formed and begin their functioning, and a number of reflexes and instinctive responses are established. After birth, the care of the child implies

above all else provision for his physical needs that he may not be handicapped in his growth and development.[6]

The period from birth to six years of age marks a progression from complete dependence on the mother to the beginning of the independence of the school years. The *crèche* or nursery where mothers may leave their children during the working day, the nursery school, and the kindergarten have in many quarters substituted professional for home care during a portion of this period.

The most important achievements of the early childhood years are acquiring the upright position and communication. The successive stages of both these processes have been scientifically observed and studied. Fig 80 shows some of the stages children pass through, though they differ in the progress they make as well as in the styles of locomotion they adopt before being able to walk. The development of vocal and manual skills cannot take place until the neurones connecting with the muscles have grown their myelin sheaths. Movement is then possible, and motor habits are formed

Behavior problems. There are some who contend that the first six years are the most important in the development of the individual, because habits then formed persist throughout life. It is difficult to say with any assurance which years are the most important, but psychoanalysts trace mental difficulties to complexes developed during this period. It seems reasonable to suppose that habits of crying to get what one wants, of rebellion, or submissiveness to harsh treatment, or of responding to too much affectionate and self-sacrificing parental care during this period will influence the responses of the individual in his mature years.

Tantrums and feeding problems are sufficiently striking to call the attention of parents to the need for assistance in the conditioning process. Nursery schools are gradually gathering

scientific knowledge concerning the nature and treatment of children at this age level, and are transmitting it to parents through publications, child-study groups, and parent-education courses and conferences.

4. CHILDHOOD

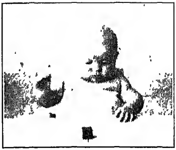
Intellect. Middle and later childhood may be conveniently thought of as extending from the period of infant care until the onset of puberty, that is, until the twelfth or thirteenth year. In general it is the elementary school period; and though health factors are as important as ever, the school program is devoted largely to the mental and social development of the child.

The intelligence quotient of children from good homes usually drops somewhat after the first testing, largely because they have lost the initial advantage of a better than average opportunity to learn the words and tasks called for on the tests. Similarly, the I.Q. of children from underprivileged homes frequently shows a rise. The I.Q., however, remains relatively constant, though individual scores on group tests may vary more widely because of the less carefully controlled conditions of group testing.

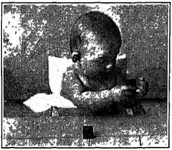
Measurements of other intellectual factors likewise show continuous growth. No year has been found when children remember better or longer than they do later, nor is there any one time when the ability to reason suddenly appears. But wide differences between different children in rates of growth in these abilities are the rule. The slow tend to remain slow, and the fast continue their more rapid pace.

The "three R's." Traditionally, the three R's, "reading, 'riting, and 'rithmetic," are to be mastered during the elementary school period. These are the child's means of contact with the social heritage. As school subjects, they have under-

Notices block (12 weeks)

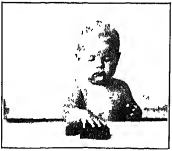


Tries to contact but fails (16 weeks)



Grasps one block (24 weeks)

Grasps and holds two blocks (28 weeks)



Handles one block after another (52 weeks)

FIG. 80. STAGES IN THE DEVELOPMENT OF COORDINATED BEHAVIOR

Progress during the first year in responding to small wooden cubes. (After Gesell.[5])

gone great changes during the past century both as to curricular materials employed and as to the methods of instruction. Less emphasis than formerly is placed on them as artistic, vocational, and recreational activities have been added to the curriculum. Individualization of instruction, with fewer schools demanding certain degrees of mastery at certain grade levels, has made school attendance more bearable to some pupils. It remains to be seen whether the relaxing of the more rigid demands results in as much learning as the pupils need.

The gang age. In general, infancy and early childhood are periods of solitary play, while middle and later childhood see the development of groups, teams, clubs, and gangs. Members are usually of the same sex, illustrating Freud's so-called homosexual stage.

These organizations are often formed by the children themselves, and show many similarities to primitive tribes. A leader is chosen, usually for his physical prowess, and the members are bound, often by mighty oaths, to abide by the rules, the most frequently found being not to tell on any of the members of the gang.[7]

The virtues of loyalty and helpfulness maintain within the group, but to those outside almost any treachery or violence is commendable. Thus what are known as the "in-group" virtues, found in adolescent and adult organizations, appear spontaneously. People apparently do not need to be taught altruistic behavior so much as they need to learn when to employ it, and how to extend it to the "out-groups," that is, to those outside their own circle.

So-called extracurricular activities, including athletics, hobby clubs, and the like, aim to control the group activities of boys and girls of this age and direct them into useful or at least harmless channels.

5. ADOLESCENCE

Puberty. The period of adolescence begins at puberty, or the age at which the individual is first capable of bearing or begetting children, usually about the thirteenth year in girls and the fourteenth in boys. The variability is quite wide, however, since occasionally pubertal changes occur quite normally as much as three or four years earlier or later, owing, no doubt, largely to glandular differences. Adolescence extends to complete physical maturity. While there is no definite point at which it may be said that adolescence ends, it is convenient to consider it as corresponding with the -teen ages, though it may quite normally extend into the early twenties.

The maturing of the sex functions, referred to as the onset of puberty, is evidenced by a number of bodily changes. In girls it is marked by the first menstrual period, which recurs at intervals of one lunar month until the menopause in the forties or fifties when the capacity for child-bearing is at an end. In both sexes, the maturing of the sex organs and a number of secondary sex characters such as the growth of body hair, the deepening of the voice, lengthening of the face, and others show that the child is growing up, though the increase in height is as a rule not so rapid as in the pre-adolescent years.

Storm and stress. Intellectual growth continues with no significant change in rate through the pre-adolescent and adolescent years; but in many the emotional life seems to be more irregular. It is the age of violent and sentimental love affairs, of misunderstandings, and family disputes. It is the age when those with a literary inclination confide their day-dreams, troubles, and "crushes" to the pages of a diary,[8] and when social and religious questions may trouble the more thoughtful. And it is the age when juvenile gangs harden into

organizations of young desperadoes, and when delinquency of one sort or another flourishes.

The reason for all these things is difficult to determine in individual cases. The rapid and somewhat uncoordinated growth of bones, muscles, and glands is no doubt responsible for some of the characteristics of the "awkward age," but there is a further reason for the storm and stress that is sometimes found during the adolescent years. As the gradual process of maturing draws to a close, the narrow environment of childhood, which has been gradually expanding, becomes more and more complicated until the individual must accustom himself to the complexities of the adult world.

A scale of increasing environmental complexity might be drawn up as follows: the womb, cradle, nursery, house, yard, street, school, neighborhood, country, world. However, these are but places or geographical delineations, which do no more than suggest the environmental limitations thrown around the immature for their protection.

The house, with its family circle, is no longer an institution which exists, so far as the child is concerned, for his protection and care, and which is run fairly successfully on an autocratic basis because of childish weakness and ignorance. It has become a place where he has responsibilities as well, and where things are expected of him which may not seem wise to his growing intelligence. It has become a place where the father, whom he may earlier have confused with God, exhibits very human weaknesses, and where cross currents of selfishness, ill temper, and narrow-minded and petty exactions do not harmonize with youthful ideals. The child is becoming an adult, an individual, and must find his place somewhere in this and other social groupings. The adjustments to these new and more complicated conditions are largely responsible for the emotional storm and stress of adolescence, when it occurs.

They may be made unwisely in the ways outlined in an earlier chapter, or they may be made more intelligently.

Juvenile delinquency. A number of factors contribute to delinquency and crime during the adolescent years. The theory of inherited criminality has been rather completely discredited. A more plausible reason for anti-social behavior at this level is to be found in the failure of the individual to satisfy his needs in social ways. Or perhaps one should say it the other way around: the failure of society to adjust the environment of youth to its capacities and needs.

It has been found[9] that over fifty per cent of the first known delinquencies of reformatory groups occur before fourteen years of age, ten per cent before the age of ten, and many as early as the sixth year or before.

Delinquency is resorted to for various reasons; as an escape from the disagreeable, as a compensation for failure, as a source of adventure, and as a means of livelihood. Instruction in criminal ways is provided in many homes, especially in thieving. It is furnished in motion pictures, in neighborhood gangs, and in penal and corrective institutions. Successful criminals achieve considerable publicity, and the successes of many wealthy citizens may seem to the youthful mind to have been achieved if not by breaking the laws, at least by their evasion.

In the larger cities are found what are called interstitial or blighted areas,[10] usually between the business section and the better residential streets. These are regions of cheap rooming-houses, and of a migratory population often regarded as of an inferior race or of a lower cultural level, where the example of the elders, overcrowding, and the absence of playgrounds and other recreational opportunities make a career of crime a natural outlet for youthful energy.

Social control. A number of agencies of social control seek

to combat these tendencies. Municipalities, working through various organizations, are gradually awakening to the effect of unhealthy environmental conditions on juvenile behavior and are providing better housing, parks, and playgrounds. Library facilities could well be increased, and supplemented by municipal shops where heavy tools could be used, hand tools borrowed, and expert guidance given in industrial arts and special crafts.

The home as an institution in the earlier frontier days used to furnish an opportunity for many kinds of labor, but now the acres of farm land do not always provide a living for the family, and the crowded city flat, supplemented by commercialized amusements, hardly creates an environment in which youth can develop most advantageously. The decrease in opportunities for employment for young people adds to the difficulty of social adjustment.

The school has made strenuous efforts to cope with delinquent tendencies in children, some of them more effective than others. The negative method of punishment for misdemeanors used to be the vogue. Mention that writers have made of their school days[11] tends to bear out the contention of mental hygienists, however, to the effect that at best brutality engenders despair, hatred, and rebellion, and serves as a rather ineffectual foundation for the building of the good life. Despite all this, however, corporal punishment and fear still bolster up discipline, though isolation from the group, low marks, suspension, and expulsion are used when it is deemed necessary.

On the positive side, mere school attendance tends to exert a helpful control, as evidenced by the increase in juvenile delinquency in the years immediately after pupils leave school. The broad program of activities offered allows pupils of varied interests and abilities to find something suited to their needs.

Furthermore, such a program, with less emphasis upon specific requirements in such subjects as algebra and Latin, tends to encourage pupils to continue in school instead of discouraging them and driving them away.

Character-education programs. A number of specific attempts have been made to direct pupils away from anti-social behavior. These are often called character-education programs, though the vague and sometimes goody-goody use of the term makes it none too satisfactory. The word "eupedic" has been suggested as a substitute.[12] A eupedic program would be one aimed at the better individual integration and social adjustment of the pupils apart from any scholastic or practical values it might have.

One type of program involves the use of mottoes, rules, codes, and special lessons whose aim is to make the boys and girls into better men and women. These may be classified as *verbal* improvement methods because all the work is done on the verbal or language level. A motto or a code, if understood and in general accepted, may be of value, but it is not apt to have much influence on the actual conduct of the children.

A second type of program involves the use of *rating scales.* A list of commendable traits is drawn up — or perhaps just one is selected, which is usually called citizenship — and teachers rate pupils, or pupils rate each other, with respect to it. As a research technique properly handled, or as a part of a system of pupil records, some value is to be found in rating devices. It may even be admitted that they are of value in emphasizing the importance of other than scholastic objectives at teachers' meetings. But the vague definition of the traits, the uncertain criteria by which they are judged, the difficulty of classifying behavior under the proper heads, and the uses to which they are sometimes put cause such scales to be of dubious value in a eupedic program.

A third type of program involves the use of *guidance* and counseling. This may be done effectively through group discussions of problems of conduct, and also individually by conferences, with the results of tests and other records at the disposal of the counselor. Theoretically, at least, actual life problems as they present themselves to the pupils should be used; but these are often too personal, trivial, or scattered to form a basis for a program. A prearranged schedule will cover more problems, but runs into the danger of being too artificial to be significant to the pupils. Both methods need to be employed if the best results are to be obtained.

A fourth type of program involves a reorganization of the *course of study* with eupedic aims uppermost. The social studies are at present undergoing the greatest changes in this direction, though the others are modified in their selection of materials and methods of instruction toward the attainment of these objectives.

A fifth type of program involves a *restructuring* of the whole school program. It includes details of pupil classification, records, counseling, hygiene, and recreation, a system of individualization of instruction, and a reorganization of courses of study and pupil activities in the light of pupil needs. Only a few schools have attained to such comprehensive modifications of their program, but the movement is gaining headway and may be the direction which will be taken by schools of the future.[13]

6. MATURITY

Growth and decline. The sixteenth year is the time when the mean mental age of unselected subjects has ceased to improve perceptibly. Eighteen is the common legal marriage age for women and twenty-one for men, though the

laws vary. Youth merges into adulthood as each preceding period merges into the next, with no sharp line of demarcation between them.

The rate of learning under controlled conditions seems to be at its height in the twenties, with only a very gradual decline beginning in the late thirties. The time it takes to learn a number of isolated facts, however, may not be a fair measure of intellectual ability, for it does not take into account the choice of things learned, or the interpretations involved in making judgments about them, which the added years of learning make available. Scientific contributions reach their modal point around the thirty-fifth year, though mathematics is an exception in that the outstanding contributions in that field have been made by those still in their twenties, as is the case also in the fine arts.[14]

Emotional maturity. There is often a peculiar discrepancy between intellectual and emotional maturity. Everyone knows able business men whose recreations and artistic appreciations are on an early adolescent or even a prepubertal level, scientists and scholars whose emotionalized prejudices, apart from their own specialization, are juvenile, and teachers and parents who might be adequately described as emotionally infantile.

Such are cases of fixation on an earlier level of development. They need the slang advice, "Be your age," though it is probably too late for advice to do them any good. There is some hope that the broader educational ideals which are receiving wider acceptance may result in fewer cases of adult maladjustment.

On the other hand, there is the very definite danger of making things too easy for the children so that when they become adults and face real difficulties they will look around for somebody to tell them what to do. These are the people who

"can't take it," as the phrase is, when they are thwarted. The causes of such weakness can only be suspected, since the evidence is by no means clear. Certainly older educational methods in the home and the school have developed their share of weaklings. And yet obstacles which are not subject to control seem to be sufficiently numerous to give people experiences in meeting them.

Social conflict. An economically self-sufficient community, the members of which all follow the same religious and social customs handed down from generations past, with no contact with the world outside would be in substantial agreement concerning principles and methods of education and social control. The younger generation would present no serious problems to themselves or to others. All would do what was expected of them because it would be the only thing they would know to do. Such a community to a considerable degree was Sparta, as was also Athens before the Persian wars. So also were the English towns before the Crusaders brought back stories of the Moslem civilization, and so, to no small extent, were the American villages before the railroad, telegraph, newspaper, and radio began bringing in religious and social ideas from everywhere to every home. Such comparative isolation is no longer possible, however. Customs, attitudes, and ideas come everywhere into conflict.

Folkways and mores. The folkways[15] are the customary ways which people have of doing things. They are quite taken for granted until there is contact with different folkways. Strange ways are considered inferior, and those outsiders who practice them have been called barbarians. Anyone within the group who begins to follow alien folkways is often ostracized, until they become commonly accepted, when the conservers of the old exclaim, "What are we coming to!"

The mores are the folkways which have some religious or

social function in the preservation of the group. They are what determine right and wrong for the group, and they tend to remain rigid, though modifications creep in, and changes may be wrought in them — but only at considerable cost. Individuals are quite helpless in opposing them, and can find a solution only in yielding or in escape to the support of groups of like-minded people.

Conflicts between members of a family or members of a larger social group are usually due to social change affecting the folkways and mores. For example, there is the conflict between the old and well established and the new or newly discovered. The old is believed to be good, while the new is considered bad, harmful, or unwise. The point of conflict, for example, may be the use of tobacco, the form of the wedding ceremony, habits of dress, or the form of government.

The choice between the two conflicting ways may be made blindly by the individual or the group; or it may be made on specific issues in terms of the consequences. In any case there will be a conflict between individuals and groups which will have to be worked out on the basis of the many considerations involved. Sometimes the police or even the military have to be called in to help settle human conflicts, but other means than force are available. The courts and corrective institutions may so operate, as may religious and social agencies.

Most fundamental, however, is the school. Its function is to provide a restricted environment in which maturing individuals may acquire the knowledge, habits, and skills and attitudes which they can use as they grow older, to meet the problems which confront them more intelligently and more wisely. Its program and the methods it employs, however, must be continuously modified, in the light of social change and in harmony with the constantly increasing knowledge of child nature.

Summary. To understand the growing child in relation to

his expanding environment is the all-important task of the teacher. Adult standards of what the child should know, do, or be cannot be imposed without reference to what the child in his environment is. Hereditary factors combining with growth experience in each individual create a unique product, the individual. The development of the individual from infancy through childhood, adolescence, and maturity is guarded more or less satisfactorily by a number of social agencies, among which the home and the school share the greatest responsibility.

The function of the school is not merely to inculcate knowledge and develop skills, but to further the development of the individuals under its care that they may become well-integrated, well-adjusted beings, capable of participating with others in the activities which make for the common welfare.

QUESTIONS

1. Distinguish between natural and social inheritance.
2. Cite some supposed personality characteristics of different racial or national groups. What evidence is there for the generalizations?
3. What evidence of a lack of understanding is there in the question: "Which is more important, heredity or environment?"
4. What are some of the habits that need to be formed at the early childhood level?
5. Compare the importance of verbal knowledge and social attitudes at the childhood level.
6. Show how the increase in complexity of the social or mental environment of the adolescent is much more rapid than that of his physical environment.
7. Describe any mental conflicts of the "storm-and-stress" period with which you may be familiar.
8. What influences do you think have been most effective in the development of your character? Is one's own testimony in this respect valid?

9. What evidences of immaturity have you witnessed in teachers? In other adults?
10. What is meant by the statement that the mores determine what is right and wrong for the group? Do mores differ among different groups? Illustrate.
11. Cite any specific instances you can think of which illustrate the statement that: To understand the growing child in relation to his environment is the all-important task of the teacher.

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1. See E. G. Conklin, **Heredity and Environment in the Development of Men.* Princeton, University Press, 1929.
   Mendel's experiments as he himself described them are to be found in his "Experiments in Plant Hybridisation," in *Mendel's Principles of Heredity*, by William Bateson, Cambridge, University Press, 1913.
2. The curves are plotted from G. S. Hall, *Adolescence*, New York, Appleton, 1904.
   Table I, p. 7, the data for which were obtained from Boas's combined measurements of 45,151 boys and 43,298 girls.
3. A. Schittenhelm (editor), *Lehrbuch der Rontgendiagnostik.* Berlin, Julius Springer, 1924. Fig. 23, p. 1168 of "Rontgenuntersuchung bei Erkrankungen der endokrinen Drusen, by M. Burger and H. Schlecht. (By permission.)
4. The irregularities in growth are shown in Harris, Jackson, Patterson, and Scammon, *The Measurement of Man,* Minneapolis, University of Minnesota Press, 1930, *Part IV, "The Measurement of the Body in Childhood," by R. E. Scammon.
5. By permission from Dr. Arnold Gesell: *How a Baby Grows, a Pictorial Guide for Observing Infant Growth and Individuality.* See also, by the same author, *Infancy and Human Growth.* New York, Macmillan, 1928.
6. See Fowler D. Brooks, **Child Psychology,* Boston, Houghton Mifflin, 1937. This is probably the best and most complete single reference on the subject.
7. See P H. Furfey, *The Gang Age*, Boston, Houghton Mifflin, 1926, and *The Growing Boy; Case Studies of Developmental Age*, New York, Macmillan, 1930.

The gang illustrates a phenomenon known as ethnocentrism, concerning which see Young's *Source Book for Social Psychology*, *pp. 59–75.

8. O Kupky, **The Religious Development of Adolescents Based on Their Literary Productions* New York, Macmillan, 1928.

A number of volumes have been written on Adolescence, the first of which was G. S. Hall's *Adolescence*, 2 vols., New York, Appleton, 1904, which has been shortened into the single volume, *Youth, Its Education, Regimen, and Hygiene*, New York, Appleton, 1921. Other volumes are R. W. Pringle, *Adolescence and High School Problems*, New York, Heath, 1922, C S. Read, *The Struggles of Male Adolescence*, New York, Dodd, Mead, 1928, L. S Hollingworth, *The Psychology of the Adolescent*, New York, Appleton, 1928; F. D. Brooks, *The Psychology of Adolescence*, Boston, Houghton Mifflin, 1929; F. E. Williams, *Adolescence; Studies in Mental Hygiene*, New York, Farrar and Rinehart, 1930.

9. S. Glueck and E T. Glueck, *500 Criminal Careers*. New York, Knopf, 1930. See also, by the same authors, *One Thousand Juvenile Delinquents*. Cambridge, Mass., Harvard University Press, 1934.

10. C. R. Shaw, *Delinquency Areas* University of Chicago Press, 1929.

11. Ella Woodyard, "Evidence on the Influence of Rewards and Punishments from the History of Education," in E. L Thorndike, *The Psychology of Wants, Interests, and Attitudes*. New York, Appleton-Century, 1935, *chap. x.

12 Pronounced u-pēd'-ic. See W. C. Trow, "Character Education — Must It First Become a Fad?" *The Nation's Schools*, **16**, 5, 1935, pp. 21–23, and "Adjustment and Values," *School and Society*, **43**, 1103, 1936, pp. 209–214. See also W. C. Trow, R M. Zapf, and H. C McKown, *The Junior Citizen*, New York; McGraw-Hill, 1937, a series of pamphlets designed primarily for use in home rooms for the upper grades or junior high school.

13. J W. Wrightstone, **Appraisal of Newer Practices in Selected Public Schools*. New York, Teachers College, Columbia University, 1935

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14. H. C. Lehman, "The Chronological Ages of Greatest Productivity: Chemists, Inventors, Poets, *et altera*," *Psychol. Bull.*, 1935, **32**, 676. (Abstract.)

15. W. G. Sumner, *Folkways*. Boston, Ginn, 1906.

Sumner is the authoritative writer on the folkways and mores. The characteristics of the phenomena are described throughout the book, though the first two chapters give them a somewhat systematic treatment. See also K. Young, *Source Book for Social Psychology*, New York, Knopf, 1927, +chap. v, for selected readings

In the *Readings in Psychology*, chap. VII, are selections on the heredity-environment problem, and in chap. XXII on the relation between social institutions and social behavior. The *Readings in Educational Psychology* contains a number of pertinent selections: chap. III on sociological and environmental foundations of behavior, chap. IV on the general nature of growth, chap. XI on character formation and social functioning, chap. XXI on applications of psychology to the modern school, and chap. XXV on special problems of childhood, adolescence, and maturity.

SUPPLEMENTARY BOOK LIST

A number of books relating more or less closely to the field of educational psychology as broadly interpreted are listed below. The titles are presented in two lists: Group I is made up of the more professional writings which serve to supplement the material in the text. Group II is made up of more popular volumes, or those written primarily for the lay reader which discuss various phases of life and adjustment, but which are not essentially pedagogical in nature.

Group I

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GLOSSARY

It is hoped that this glossary will be of assistance in forming the technical vocabulary of the student without contributing to uncomprehending verbalism. Due credit is herewith given to the *Dictionary of Psychology*, edited by Howard C. Warren, and published by Houghton Mifflin Company, 1934, to which reference should be made for more complete definitions.

The following abbreviations have been used in this Glossary:

abv.	abbreviation	e.g.	for example
adj.	adjective	i.e.	that is
adv.	adverb	pl.	plural
a.n.	abstract noun	p.n.	personal noun
ant.	antonym	syn.	synonym
cf.	compare	v.	verb

Diacritical marks have been inserted in certain cases in which difficulty in pronunciation might be experienced.

abnormal deviating widely from the norm or average, referring usually to low intelligence or mental derangement.

abstraction the process of observing or considering some part or characteristic of a situation independently of the rest of it; the part so considered.

acceleration 1. rate of increase of improvement; 2. a plan of promotion by which bright children proceed through the school grades at the rate they are capable of going. Cf. *enrichment*.

adaptation 1. change in the form or function of an organism giving it a greater survival value; 2. a change in sensory experience resulting from long-continued and unchanging stimulation; 3. a change in the retina following a change in illumination and producing clearer vision under the new conditions.

adolescence the period of individual human development from the onset of puberty to adulthood. Syn. the "*-teen age*."

adrenal glands endocrine glands located near the kidneys. The *medulla* (inner portion) secretes *epineph'rin* (adren'alin) the action of which is similar to that of the sympathetic segment

of the autonomic nervous system; the *cortex* (outer covering) secretes *cortin* affecting growth and sex maturation.

æsthetics or *esthetics* the scientific investigation of the nature and characteristics of beauty and ugliness, or of pleasantness and unpleasantness, and of the nature of the stimuli which arouse these feelings. A.n., *(a)estheticism;* p.n. *(a)esthete.*

afferent conducting toward the center, e.g., applied to nerves. Syn., *sensory;* ant., *efferent, motor.*

ambiversion the attitude or personality type between the extremes of introversion and extroversion. P.n., *ambivert.*

analogy similarity or partial identity in some significant particular between two otherwise different and separate conditions or events. Ant., *homology;* adj., *analogous* (-gŭs). *Analogies test* a test of logical relations such that the first item bears the same relation to the second as the third does to a fourth which must be found.

analysis separating an experience or other datum into its parts or constituents. V., *analyze,* adj., *analytic,* ant., *synthesis.*

annoyer a condition or state of affairs which produces avoidance responses (or does not produce approach responses); one which starts goal-seeking and may produce a feeling of unpleasantness. Ant., *satisfier.*

anterior before, in front of, ventral. Ant., *posterior.*

aphasia a cerebral disorder marked by an inability to understand spoken or written words, or sometimes to say the words intended. *Motor* and *sensory aphasia* are distinguished.

apperception 1. perception focussed upon a clearly distinguished part of the perceived whole, involving a greater degree of meaning or significance for the observer. *Apperceptive mass* according to Herbart, the ideas already present in mind which determine the way in which new objects or relationships will be perceived, and hence responded to.

appraisal estimation of value on the basis of personal judgment, allowing the use of available quantitative measures.

arithmĕt′ic mean the measure of central tendency obtained by dividing the sum of the numbers or scores by their number. Syn., *mean, average.*

association the relationship between conscious experiences primarily on the basis of succession and contiguity. *Associationism* and *associationists* refer to the British school of psychology which made association their basic principle. *Association test* a test aimed to discover the subject's word-reaction time or the logical relation of his verbal responses. In *controlled association* the stimulus word and the logical relation desired are given, in *free association* the response is unrestricted.

associative shifting the principle of learning developed by Thorndike corresponding to association on the one hand and the conditioned reflex on the other.

asthenic a type of body build described by Kretschmer characterized by slenderness and long limbs and fingers and the personality characteristics of schizophrenia. Syn., *leptosome.*

astig'matism a visual defect due to inexact refraction of light through the cornea or the lens.

attention variously defined as a state of consciousness, a process, a sensory adjustment, and the application of intellectual energy or conation, in which certain objects or portions of experience are more vivid or appear with greater clarity. *span of* — the number of objects that can be seen in a time so brief as to exclude eye movements, measured by means of a special exposure apparatus called a *tachistoscope* (tâ-kĭs'tō-scōp).

attitude a mental disposition, readiness, or set, often accompanied by affective and emotional elements, and implying approach or acceptance, or avoidance or rejection.

aussage test (ows'sah-ga) a test of fidelity of report of objects or events briefly seen.

autonomic nervous system a system of ganglia and motor nerves innervating smooth muscles and glands; functionally divided into two segments, (1) the *sympathetic* or thoracico-lumbar and (2) the *parasympathetic* or cranio-sacral.

average deviation a measure of variability; the arithmetic mean (average) of the amounts by which each item or score in a series differs from the average of the items. Syn., *mean deviation, mean variation.* Abv., *A D., M.D., M.V.*

basilar membrane (băs'ĭ-ler) the vibrating portion of the cochlea in the inner ear.

behavior any or all responses of an organism; what it does. Adj., *behavioral*. *Behaviorism* a school of psychology confining itself exclusively to a study of the muscular and glandular responses. Adj., *behavioristic*. Cf. *conduct* behavior involving ethical or other normative considerations.

binocular rivalry alternation of sensations from one eye to the other when the eyes are simultaneously stimulated with different colors. Syn., *retinal rivalry*.

binocular vision seeing with the two eyes coming to a focus on the same field.

brain the nerve structure lying within the skull, the main parts of which are the *cĕr'ebrum* (or cĕr'ebral hemispheres), *midbrain*, *cĕr'ebell'um*, *pons*, and *medulla*. Syn., *enceph'alon*.

case study the collection and record of significant information concerning a normal or abnormal individual as a basis for judgment as to the treatment he should receive. A *case history* emphasizes the genetic or developmental aspect.

character in general those phases of human personality which make for individual integration and social adjustment, and which are in consistent harmony with the mores, particularly the accepted moral standards.

class interval the number of equal units of measurement or the range of such units arbitrarily selected into which a frequency distribution is divided. Syn., *step interval*.

cochlea (kŏk'lē-a) a structure of the inner ear containing the organ of hearing.

coefficient of correlation a number, between + 1.00 and − 1.00 which indicates the degree of relationship between two variables; e.g., between the intelligence and achievement scores of the same group of individuals.

color-blindness a visual defect, the person afflicted being unable to distinguish certain hues, usually red and green.

color wheel laboratory apparatus for mixing colors.

comparative psychology the branch of psychology which investi-

gates the relation between species with respect to psychological factors. Syn., *animal psychology.*

compensation the process of making up for a weakness or undesirable quality by exaggerating some other quality for the purpose, according to Adler, of overcoming inferiority and attaining the superiority goal.

com'plex 1. composed of varied or interrelated parts; 2. a group of ideas emotionally toned, partially unconscious or repressed.

conditional reflex or *conditioned reflex* the attachment of a response to a stimulus that did not previously call it forth by the repeated simultaneous presentation of that stimulus with an effective one; derived from Pavlov's experimentation.

con'flict the state of tension resulting from the existence of two or more mutually contradictory needs or desires.

control group a number of subjects used in an experiment and resembling the *experimental group* in nature and treatment in all essential respects except certain prescribed conditions to determine by comparison the effect of those conditions.

cortex rind, bark, or covering; refers usually to the outer layers of the cerebrum.

cranial nerve one of the 13 pairs of nerves branching from the brain stem within the cranium.

cretinism a condition of retarded physical and mental development due to thyroid deficiency. P.n., *cretin;* syn., *myxedema.*

cue a secondary stimulus, some seemingly less significant part of a situation the response to which, rightly or wrongly, serves as the response to the total situation.

deduction the process of reasoning from a general, accepted principle (*major premise* of a *syllogism*) to a specific, concrete truth or proposition. Ant., *induction.*

delusion an erroneous belief or set of beliefs held usually by a mentally deranged individual about himself and not subject to correction by reason.

diagnosis the procedure employed to discover or identify the nature of a disease or disorder. Adj., *diagnostic;* v., *diagnose.*

dichotomy (dī-kot'o-mĭ) the division of items into two groups

made up respectively of those which have and those which have not a certain character.

distribution an arrangement of data by means of a table or graph showing the frequency of occurrence of successive groups of values or scores.

drive an organic activity or condition (e.g., hunger) or mental set producing approach or avoidance responses. Syn., *urge*, *motive* (in a specific situation), *instinct* (older usage).

dysplastic body build which does not fit into Kretschmer's pyknic, athletic, asthenic classification.

education the development of individual abilities, knowledge and skills by means of a controlled environment and involving teaching or instruction.

educational psychology the investigation of psychological problems in the field of education; the application of psychological techniques, knowledge and principles to educational theory and practice.

efferent conducting away from the center, e.g., applied to nerves. Syn., *motor;* ant., *afferent, sensory.*

ego 1. the self; 2. that function of the mind, partly conscious and partly unconscious motivated by the id but in contact through the senses with the external world of reality.

emotion a complex mental experience involving instinctive responses and organic sensations, and having a strong feeling tone of pleasantness or unpleasantness.

empathy the imaginal and emotional identification of oneself with another person or with the elements of a work of art.

empirical 1. pertaining to experience; 2. pertaining to scientific (inductive) observation and experimentation.

endocrine a ductless gland secreting a chemical substance, *hormone* or *autocoid*, into the blood stream and having important physiological and often psychological significance.

enrichment a plan of promotion by which bright children proceed through the grades at the regular rate but are provided with additional educative tasks and activities. Cf. *acceleration.*

environment all influences acting from without upon an organism.

experimentation observation in which conditions are under control for the purposes of scientific investigation.

extroversion or *extraversion* an attitude or personality type in which the libido or psychic energy is turned outward toward others (Jung). P.n., *extrovert;* ant., *introversion.*

family constellation the number, birth sequence, and characteristics of a family as influencing the life of a child.

feeblemindedness mental inferiority, below normal intelligence; usually, interpreted as an I.Q. of less than 70.

fixation 1. the definite acquisition of a mental or motor habit; 2. the focusing of the eyes upon a certain point; 3. the attachment of the libido upon a love object; 4. the arrest of the libido at an earlier stage of development. V., *fixate.*

focus 1 the point at which rays of light passing through a lens converge; 2. *focus of attention* the clearest portion of perceptual or ideational experience.

folkways patterns of individual and group behavior established by tradition. Syn., *conventions;* cf. *mores.*

forgetting the loss of capacity to recall an event or perform an act previously experienced or acquired. The rate of forgetting may be measured by the *prompting method* or by the *saving method.* The *curve of forgetting* is a graph representing the rate of forgetting.

fovea a small depression in the retina, the center of fixation, the area of clearest vision, where only cones are found.

frequency the number of values or scores appearing in a certain class or sample.

frequency polygon a graph representing a distribution by means of a closed figure of straight lines; height above the horizontal indicates frequency and distance to the right from the vertical, scores or values. Syn., *frequency curve, surface of frequency.*

fringe the scarcely noticed but often important meanings and relationships accompanying perceptual or imaginal experience.

fusion the combined unanalyzed effect of two or more stimuli acting on one sense, e.g., a different tone in each ear (*binaural fusion*) a different color on each retina making a single visual

impression (*binocular fusion*) or two tones sounding simultaneously which *blend* to a greater or lesser degree (*tonal fusion*).

g (general) factor the element basic to mental ability and constant in any one individual in all situations, according to Spearman's *two-factor theory*. Cf. *s factor*.

ganglion a cluster of nerve cells lying outside the spinal cord (e.g., sympathetic or spinal ganglion). Pl., *ganglia*.

genealogy the investigation of ancestry.

genetic psychology the phase of psychology concerned with the origin and development of behavioral and thought processes. Sometimes used synonymously with *child psychology*, and *developmental psychology*.

Gestalt 1. form, arrangement, pattern, configuration; 2. a system of psychology viewing mental life as made up of organic patterned wholes not derived from but rather determining the nature of the parts of which they are composed.

gonad a gland producing sex cells and also having an endocrine function affecting growth and physiological and psychological sex characteristics: male, *testis;* female, *ovary*.

group thinking the process of discovering the solution of a problem by the individuals of a face-to-face group.

growth increase in size or complexity primarily as a natural process.

guidance the process of assisting an individual in the solution of his life problems particularly in relation to educational and vocational choices.

gustation the sense of taste. Adj., *gustatory*.

habit an acquired response, referring to a learned motor coordination, or to an available response attaching to a stimulus which did not previously call it forth.

hallucination a subjective experience without any discoverable objective stimulus interpreted as an actual and often vivid perception, and usually accompanying mentally deranged states. Cf. *illusion; delusion.*

hedonism the theory that people act so as to attain pleasant and avoid unpleasant feeling. P.n., *hedonist;* adj., *hedonistic.*

heredity the transmission of characters through the germ cells from parents to offspring.

heterogene'ity a condition involving differences within a group; applied to differences of intelligence or ability in a grade. Adj., *heteroge'neous;* ant., *homogeneity.*

hierarchy of habits the organization of habits in sensory-motor learning which necessitates the formation of the simpler, lower-order habits before those of the next higher order are formed, an explanation of plateaus in learning.

histogram a graph representing a distribution by means of columns whose height shows the frequency of a class and whose position from left to right indicates the range of the scores or values.

homogene'ity similarity within a group, applied particularly to a likeness in intelligence or ability in a grade. Adj., *homoge'-neous;* ant., *heterogeneity.*

homosexuality sexual attraction of an individual for one of the same sex; inversion; psychoanalytical usage applies the term also to the preadolescent stage of development during which boys generally prefer association with boys and girls with girls, e.g., the gang age. Ant., *heterosexuality.*

hypero'pia or *hypermetro'pia* far sightedness, the defective refraction of light through the lens of the eye in such a way that parallel rays would come to a focus behind the retina.

hypothesis an inference derived from slight evidence or inadequate data, adopted tentatively as an explanation of observed facts; a demonstration of the truth or falsity of a hypothesis is sought by scientific means.

hysteria an unstable condition having no known physical basis, characterized by fits, paralysis, anesthesia, and the like.

id the dynamic function of the unconscious mind directed by the pleasure principle, close to the basic physiological processes.

identification a condition in which the individual more or less unconsciously behaves emotionally and otherwise as if he were some other person or creature.

idiocy the lowest grade of feeblemindedness. P.n., *idiot.*

illusion a fairly consistent error of perception; lack of correspond-

ence between what is perceived and the objective situation as it is known to exist — a phenomenon of normal experience.

image an element of conscious experience, centrally aroused, having the qualities of sensation and varying in different individuals in vividness. Syn., *memory image; centrally aroused sensation. After-image* a conscious experience following upon the cessation of stimulation having the quality of the original sensation except when in the case of vision the image appears in complementary colors = *negative after-image Eidetic imagery* imagery corresponding in vividness to the after-image and in flexibility to the memory image.

imbecility the middle range of feeblemindedness. P.n., *imbecile.*

incentive an environmental object or condition which acts as a stimulus in motivating activity in an individual (e.g., food, praise). Ant., *deterrent.*

individualized instruction instruction so arranged as to be adjusted to the stage of development and special needs of each person being instructed. Ant., *group instruction, mass education.*

individuation the gradual differentiation or emergence of a specific part activity and its development, involving varying degrees of independence, in the process of the development of the larger mass activity of which it is a part. Cf. *integration.*

induction the process of reasoning from particular cases to arrive at a generalization or general principle. Ant., *deduction.*

inferiority complex the feeling of inadequacy due to organic weakness, physical limitations and blemishes, or more broadly to social helplessness, for which, according to Adler, the individual needs to compensate. Syn., *inferiority feeling; castration complex* (Freud).

insight the comprehension of relationships in a complex situation resulting in an appropriate response.

instinct 1. innate, unlearned adaptive response to particular environmental conditions; pattern reaction; 2. inner drive leading to the satisfaction of biological needs.

integration the process by which psychological or social parts become organized into a unified whole. Applied to the uni-

fication of discordant wants and drives in the development of personality. Ant., *disintegration.*

intelligence 1. the capacity of an organism to meet adequately and adjust to a new situation; 2. success in performing certain mental tasks appearing in intelligence tests.

intelligence quotient. the ratio of *mental age,* as measured by a mental test, to chronological age; an index of brightness remaining relatively constant in any one individual. Abv., *I.Q.*

intensity the magnitude or force of a sensory experience, corresponding to the intensity of the stimulus; in the case of sound, intensity is produced by the amplitude of the vibration.

interest a positive attitude or set involving focusing attention and emotional satisfaction with relation to an object or activity.

interoceptor sensory receptor whose stimuli are within the organism.

introspection the observation and description of one's own mental states and processes.

introversion an attitude or personality type in which the libido or psychic energy is turned inward toward oneself (Jung). P.n. *introvert;* ant., *extroversion.*

intuition immediate judgment without previous thought; often an inference from incomplete or insufficient data which is accepted as true without further verification.

job analysis a detailed study of the activities involved in a task or occupation for improving performance or training workers.

kinesthē'sis the sense of movement of muscles, tendons and joints. Adj., *kinesthĕt'ic.*

learning the process of acquiring new responses to situations; applied to motor coordinations and memory, and viewed as leading to the more satisfactory adjustment of the individual; *learning curve* a graph representing progress in learning under controlled conditions; *laws of learning* explanatory principles of the learning process; *distributed repetitions* a principle of learning according to which learning is more efficient when the learning periods are shorter and spaced than when they are

longer and massed, *overlearning* continuing learning beyond the point of one correct repetition with a view to more complete and accurate recall after a period of time; *whole and part learning* applies to the effectiveness of learning (1) when the entire material is repeated and (2) when a part is repeated until learned followed by another part, and so on.

level of aspiration the degree of excellence the individual sets for himself as a goal, resulting in satisfaction or dissatisfaction according as he is successful or unsuccessful in attaining it.

libido (lĭb-ee'dō) psychoanalytical concept of sexual drive or energy. Usage makes the term variously synonymous with sex hunger, love, psychic energy.

manic-depressive insanity a mental disease or psychosis characterized by prolonged but alternating periods of excited activity and depression.

maturity the stage of complete development.

maze a laboratory device consisting of crossing pathways, some ending in blind alleys, others leading to some goal, used in controlled observations of learning.

measurement the discovery of quantitative or numerical value by comparison with a fixed standard or scale of values.

median a measure of central tendency, the mid point of a series of ranked or distributed values. Abv., *mdn.*

memory the reinstatement in consciousness of an experience together with the recognition that it has been previously experienced. *Rote memory* correct verbatim recall without respect to meaning; *memory span* the number of items presented systematically under controlled conditions which can be immediately reproduced correctly; *mnemonic device* (nē-mon'ic) a rhyme or other formula to assist in memorizing.

Mendē'lian ratio the ratio of 3 dominants to 1 recessive, Mendel's law of the hereditary transmission of unit characters.

mental test a standardized instrument for measuring the amount of human abilities, particularly intelligence.

mode a measure of central tendency; the most frequent of a series of values.

mongolism a clinical form of feeblemindedness.

mood a prolonged emotional attitude.

mō'rēs (pl.) customs regarded as right by a social group which individuals must follow for the good of the group or be penalized in various legal or extra-legal ways. Sing., *mos*, (rare).

moron an individual of the highest grade of feeblemindedness.

motivation the presentation of stimuli or incentives, or arrangement of environmental conditions in such a way as to produce certain desired types of activity.

motive a conscious experience or unconscious condition which serves as a factor in determining behavior or conduct particularly in the attainment of specific goals.

myopia near sightedness; the defective refraction of light through the lens of the eye in such a way that parallel rays come to a focus in front of the retina.

narcissism (nar'sĭs-ism) the psychoanalytical stage of self-love. Also written *narcism*. Adj., *narcissistic*.

need 1. an environmental factor or condition which is important or necessary for the full growth and development of an organism; 2. a biological condition which stimulates approach or goal-seeking behavior. Cf. *want*.

neurasthenia a condition of lack of physical and mental vigor supposedly brought on by prolonged strain or thwarting. Syn., *nervous breakdown*, *nervous prostration*.

neuron(e) a single nerve cell consisting of *dendrite*, *cell body*, and *axon(e)*; *nerve fiber* an axon or dendrite.

norm 1. a standard or pattern of accepted performance or attainment. Adj., *normative*, refers to certain objectives such as right and beauty in ethics and esthetics respectively; 2. the average score of a representative group on a standardized test.

objective (adj.) 1. having the characteristic of being verifiable by any qualified investigator, in some cases by means of a record made by physical instruments or apparatus; 2. located in space outside the body of the observer and hence verifiable by other observers (e.g., by the eye or ear, in contrast with feel-

ings and organic and kinesthetic sensations), 3. free from personal bias. A.n, *objectivity;* ant., *subjective*

objective (noun) that toward which a purposive act is directed. Cf. *goal, lure, incentive.*

Œdipus (or *Edipus*) *complex* excessive attachment of the son for the mother with a corresponding hostility for the father, a condition which psychoanalysts consider normal in childhood and remaining operative later through the unconscious.

olfaction the sense of smell. Adj., *olfactory.*

organ of Corti a structure lying along the basilar membrane in the cochlea within the inner ear and containing the hair cells which constitute the actual auditory receptor.

orientation the determination of the direction of individual adjustment with respect to temporal or spatial relations, fixed conditions, forces, ideas, or a life plan.

paranoia a mental disease or psychosis characterized by fixed, systematized delusions, but not necessarily involving any mental deterioration.

par'esis incomplete paralysis; generally refers to the effect of the germ of syphilis in the brain and spinal cord resulting in motor and reflex disorders and mental deterioration. Syn., *general paralysis.*

partial activity response to a part of or to a prepotent element in a situation apart from other aspects of the situation. Cf. *cue.* Syn., *piecemeal activity.*

percentile curve a graph representing a series of numerical values or scores; any point on the curve shows on the vertical, the score obtained and, on the horizontal, the per cent of scores below that score.

perception the awareness of objects, qualities or relations.

personal equation the constant error of an observer in recording the exact time of a series of observations.

personality 1. the total integrated organization of the psychological characteristics of an individual particularly as they affect his social adjustment; the total behavior pattern; 2. the outstanding characteristics of a person as they appeal to others.

phantasy or *fantasy* the imaginative satisfaction of unfulfilled wishes and longings. Syn., *day-dreaming, autistic thinking*.

physiological limit the limit of attainment in speed or skill enforced by the nature of the neuro-muscular organism.

pitch the quality of a tone as high or low, produced by the frequency of vibrations, measured in cycles (~) per second.

pituitary gland a small endocrine gland located at the base of the brain having an anterior and a posterior lobe, the hormones from the former affect growth, and those from the latter affect metabolism and the production of fat.

plateau a period of no progress in speed or the reduction of errors in learning, a flattening out of the learning curve.

posterior in the rear of, dorsal

prepotency the characteristic of environmental objects or conditions in relation to an organism such that they serve as stimuli to which the organism responds.

prestige (prĕs-teezh′) a reputation for achievement giving a person considerable influence and resulting in emulation.

probable error a number which indicates the limits between which an obtained quantity will lie as often as it will not (i.e., a 50-50 chance) owing to the sampling of cases used. A probable error may be obtained for an average, a coefficient of correlation, a difference, etc. Abv., *P.E.*

probability curve a graph representing a distribution of numerical values arranged as by the laws of chance or probability. Psychological measures as represented by a frequency curve tend to approach the probability curve. Syn., *normal curve, bell-shaped curve, curve of Gauss.*

projection the process of ascribing to objects or other persons by an individual an influence usually detrimental to him instead of recognizing the cause in his own weakness or insufficiency.

proprioceptor the kinesthetic and static sensory receptors.

psychiatry (sĭ-kī′a-trĭ) the theory and practice of dealing with mental disorders. Adj., *psychiat′ric.*

psychoanalysis a system of psychology and of treatment of mental disorders originated by Sigmund Freud and based upon the concept of a dynamic unconscious mind.

psychology variously defined, according to the point of view held, as the science (1) of mental life, (2) of organic life in relation to stimulus and response, (3) of behavior, (4) of the self.

psycho'sis mental disease. Pl., *psycho'sēs*.

puberty the age at which the individual is first capable of bearing or begetting offspring.

puzzle box a laboratory device consisting of a small inclosure, having a swinging gate with a more or less complicated latch operated by the subject; used in the controlled observation of learning and problem-solving behavior.

pyknic a type of body build described by Kretschmer characterized by rounded trunk, short legs, thick neck and a tendency toward obesity and associated with the alternating personality characteristics of manic-depressive psychosis.

quartile (quar'tĭl) the points which divide a series of items, ranked or in the form of a frequency distribution, into quarters. Sometimes used to designate the interval or quarter.

range a measure of variability; the total distance between and including the highest and lowest values, indicated by the difference between them.

rank position in a series arranged in order from the highest or lowest value.

rationalization the process of presenting acceptable reasons or excuses for justifying an act or opinion really based on other motives less acceptable to the individual or group; the rationalizer may not realize he is not giving the true reason or motive.

reaction a change (muscular, glandular, or other) in an organism resulting from stimulation. Syn., *response*. *Reaction experiment* an experiment to determine *reaction time*, i.e., the time between the presentation of a stimulus and the response of the subject to it.

reliability 1. degree of dependability of report or testimony; 2. the self-consistency of a measuring device; the degree to which two administrations of a test (or two halves or forms) obtain the same result. It may be indicated by a *coefficient of reliability*.

research' the investigation of phenomena from original data or first-hand observation.

s (specific) factors the element of mentality which varies for different abilities of the individual according to Spearman's *two-factor theory*. Cf., *g factor*.

sampling a selection of cases for study representative of the whole group or population from which they are selected.

satisfier a condition or state of affairs which produces approach responses (or does not produce avoidance responses); one which brings a series of goal-seeking responses to a close; may produce a feeling of pleasantness. Ant., *annoyer*.

scale 1. a progressive series of values having numerical equivalents serving as a standard with which a specific performance or other data may be compared for measuring; e.g., *handwriting scale, composition scale, rating scale*. 2. A conventional series of musical notes arranged in order according to pitch.

scatter diagram a two-way plotting of a series of paired measures, e.g., a graphical representation of correlation.

schizophrenia (skiz'o-frē'nĭ-a) a mental disease or psychosis involving hallucinations, delusions and other forms of dissociation. Formerly called *dementia praecox*.

science organized knowledge obtained by systematic investigation; *scientific method* a systematic program of investigation to obtain exact knowledge and involving a proper regard for accuracy, precision, and logical inference.

score a credit or weighted value given to the response on a test item or the sum of such credits on a test. V., *score*.

security a condition of freedom from anxiety involving confidence between the individuals concerned.

sensation the process of sensing; the experience aroused by the stimulation of the sensory receptors, not further analyzable by introspection; an element of consciousness.

short-answer test a test so constructed that the person taking it may record his answers by simple marks or checks. It may or may not be standardized. Various forms have been devised,

e.g., *completion, matching, multiple choice,* and *recall.* Syn., *new-type test, objective test.*

sibling one of two or more offspring of the same parents and of either sex. Syn., *sib.*

social distance a means of expressing the degree of prejudice or antagonism between individuals or social groups.

spinal cord the nerve structure which, with the brain, is referred to as the central (as contrasted with the peripheral) nervous system, and located within the spinal column or back bone.

standard deviation a measure of variability; an average of the positive and negative deviations from the mean; the square root of the mean of the squares of the deviations from the mean of a distribution. Abv., *S.D.* or σ *(sigma).*

standardized test a test which has (1) a fixed procedure for administering it, which is (2) scored objectively, (3) reliable, and (4) valid, and for which (5) norms are provided.

static sense the sense of balance or equilibrium, referable to the semicircular canals in the inner ear.

statistics 1. the branch of mathematics which arranges and classifies groups of data numerically; 2. classified facts or data.

stereotype a set of responses or attitudes little subject to change.

stimulus 1. energy external to a sensory receptor which excites the receptor, i.e., produces a sensation (e.g., light or sound waves); 2. any object, condition, or change which alters activity (i.e., produces a response) in a living organism. Syn., *stimulus object, stimulus situation.*

strabismus a defect of eye movement due to a lack of control of the muscles which rotate the eyeball in the socket.

structure the functional organization or arrangement of parts in a whole. Applies to biological, psychological, or social phenomena. V., *restructure* to rearrange the functional parts in a total social pattern.

subjective 1. having the characteristic of being unverifiable by qualified investigators, or by physical instruments or apparatus; 2. located psychologically within the observer's body (e.g., feelings and organic and kinesthetic stimuli in contrast

with visual or auditory stimuli); 3. embodying individual bias or prejudice. A.n., *subjectivity;* ant., *objective.*

sublimation the re-directing of the libido from a sex object to a new object or aim of a socially useful nature.

super ego that function of the mind which criticizes the ego; related to early parental influences, corresponding to conscience.

symbol an object, sign, expression, or act which represents or stands for one that is usually more complex (e.g., $+$, σ, a numeral, a word, a gesture, a flag). Cf., *personification,* a symbol having human attributes.

symbolism 1. the use of symbols; 2. the systematic form taken by unconscious thoughts and dreams; the significance, which is usually sexual, is not recognized except by the psychoanalyst.

sy̆n'apse the region of contact between neurons, where the nerve current passes from the axon of one neuron to the dendrite of the one next in series; supposedly the area where change and modification takes place in learning.

synesthesia or *synæsthesia* the relatively rare attachment of one set of sensations to experiences of another sense, e.g., the sound of a bell may appear blue.

synthesis joining parts or elements of experiences or other data into a whole which may be different from a previous arrangement. V., *synthesize;* adj., *synthetic;* ant., *analysis.*

teleology the view of acts or events as in relation to, directed toward, or determined by future situations, goals, or ends. Adj., *teleological.*

temperament a permanent emotional attitude, or the general affective nature of an individual, attributed to inheritance, life history, and to the endocrines. The four classical temperaments, derived from bodily *humors* or fluids are the *choleric, melancholic, phlegmatic,* and *sanguine.* Adj., *temperamental* strong and changeable moods.

test an examination or series of tasks, an individual's performance of which serves to classify him with respect to the performance of other individuals taking the test; *mental test* a test of mental abilities, *achievement test* a test of ability in the perform-

ance of learned tasks particularly of school knowledge and skills; *individual test* a test which must be administered to one individual at a time; *group test* a test which may be administered to several individuals at a time.

thwarting the blocking of an individual in the attainment of an end or goal.

thyroid gland an endocrine gland having two lobes lying on either side of the trachea, it secretes *thyroxin*, which regulates basal metabolic rate. *Hypothyroidism* in the form of *myxoedema* or *cretinism* results in deficiencies in mentality and physical growth.

timbre (tĭm'ber or tămbr) the quality of a tone produced by its characteristic overtones.

transfer of training the improvement of one mental function through the practice of some related function.

trauma a wound, injury, or shock. Pl., *trau'mata*, adj., *traumat'ic.*

trial-and-error method a mode of learning in which various responses are made by chance or otherwise, and the successful (rewarded) responses tend to be repeated. Syn., method of trial, error, and accidental success; trial-and-success.

twins a pair of offspring produced at one birth. *Fraternal (dī'-zygot'ic) twins* are of the same or different sexes, and little if any more alike than siblings. *Identical (mon'ozygot'ic) twins* are of the same sex, very much alike, and are supposedly from the same fertilized egg, and hence have the same heredity.

tym'panum the eardrum.

umwege (um'vā-gĕ) detour, or round-about experimental set-up employed by Gestalt psychologists.

valence the force producing approach (positive) and avoidance (negative) in an organism in relation to specific stimulus objects or situations.

validity 1. the formal correctness of an inference or argument; 2. the extent of agreement between the results of a measuring device and an accepted criterion; the degree to which a test measures what it purports to measure.

variable a quantity which may have different numerical values, e.g., amount of intelligence, or degree of skill in handwriting.

verbalization, verbalism the uncritical acceptance or reproduction of definitions or other phrases as if they were explanations without any satisfactory comprehension of their meaning.

viscera the larger internal bodily organs.

want an environmental factor or condition which is not immediately present to the individual which might prove satisfying and contributory to his growth and betterment.

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